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Contents

Description of Late Cretaceous Oysters Encountered within the Clayey-Marl Bed of Sidi Assed Formation (Yefren Marl) at Wadi Ka'am Dam Area, North Western Libya

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الملخص:

يوجد نطاق بسمك حوالي مترين يحمل المحار داخل طبقات أعضاء يفرن مارل (رواسب العصر الطباشيري المتأخرة التي تشكل جزءًا من تكوين سيدي الصيد) في منطقة وادي كعام ، الواقعة بين مدينتي الخمس وزليتن ، شمال غرب ليبيا. تم جمع أجسام أحافير المحار من الموقع ثم تم تنظيفها وفرزها ودراستها في مختبر قسم علوم الأرض والبيئة. يهدف هذا البحث إلى توثيق ووصف أحافير المحار المحفوظة في منطقة الدراسة. تم إجراء مقارنة عامة بين أحافير المحار في منطقة وادي كعام وأنواع أحافير المحار المماثلة التي تم العثور عليها في نتوءات تيثيان Tethyan التي ترسبت خلال العصر الطباشيري من أجل تحديد الأنواع المختلفة من أحافير المحار. تضمن وصف الحيوانات الأحفورية السمات المورفولوجية الشائعة مثل : اتجاه الصمام ، وشكل الغلاف ، وهوية الصمامات (التناظر) ، وخط المفصلة ولوحة المفصلة ، والأسنان (نمط الأسنان) ، والعضلات (بناء العضلات) ، والزخرفة ، واتجاه ودرجة انحناء مناقير الصدفة. وفقًا للدراسة الحالية ، تم تحديد أنواع مماثلة من مواقع أخرى في Tethyan والتي تشمل : Crassostrea virginica و Ostrea franklini) Ostrea franklini camelina؟) و Crassostrea gryphoides و Striostrea.

الكلمات المفتاحية: المحار ، الأفق الحامل للمحار ، المحار المتأخر من العصر الطباشيري، منطقة وادي كعام، ملوسكا، بيفالفيا.

ABSTRACT:

About 2-meters of an oyster- bearing horizon within Yefern Marl Member strata (a Late Cretaceous deposits that make part of Sidi Assaid Formation) is encountered at Wadi Ka'am Area, located between Alkoms and Zliten Cities, North Western Libya. Oyster fossil bodies were collected from the site and then cleaned, sorted and studied at the Earth and Environment Sciences Department laboratory. This research is intended to document and describe the preserved oyster fossil bodies within the area of study. A general comparison between oyster fossils at Wadi Ka'am area and similar oyster fossil species encountered in Tethyan outcrops deposited during Cretaceous is made in order to define the different oyster fossil fauna. Description of the fossil fauna included the common morphological features such as ; valve orientation, shape of the shell, identity of valves (symmetry), the hinge line and the hinge plate, dentition (teeth pattern), musculature (muscle construction), ornamentations, and direction and degree of curvature of the shell beaks. According to the present investigation, a comparable species from another Tethyan sites were determined which include; **Crassostrea virginica, Ostrea franklini camelina (Ostrea franklini?), Crassostrea gryphoides** and **Striostrea**.

Keywords : Oysters, Oyster-bearing horizon, Late Cretaceous oysters, Wadi Ka'am area, Mollusca, Bivalvia.

1- Introduction

1-1 General information and location of study area

Wadi Ka'am Dam is built within Ka'am Region (the so called Cinyps in Greek) during the period 1974-1979. It is located about 25 km distant from Alkums City to the east and about 22 km distant from Zliten City to the west in Misrata District (Fig-1). The main purpose of the Dam is to supply water for irrigation. Cretaceous rocks in the area of study is distinguished into two formations : the lower is Sidi Assed Formation which is divided into Ain Tobi Member at the base (Dolomitic Limestone) and Yefren Marl Member on the top (Marl with claystone and gypsum crystals as well as Oyster bearing horizon), and the upper formation is Nalut (Dolomitic Limestone to Dolomite with chert layers and nodules). The two Cretaceous formations were separated by a distinct unconformity (paraconformity) (Mann, 1975).

A sedimentary succession of about (8) meters thick consisting at its base of an Oyster-bearing horizon (about 1.80 meters thick) outcropped alongside Wadi Ka'am Dam and several meters distant from the artificial lake of Wadi Ka"am (Fig-2). This horizon is the subject of the current study which makes part from Sidi Assed Formation (Yefren Member) deposited in Cretaceous. (Note : the lower member of Sidi Assed Fm. which is called Ain Tobi Mb. is missing in this outcrop) (Fig-5).

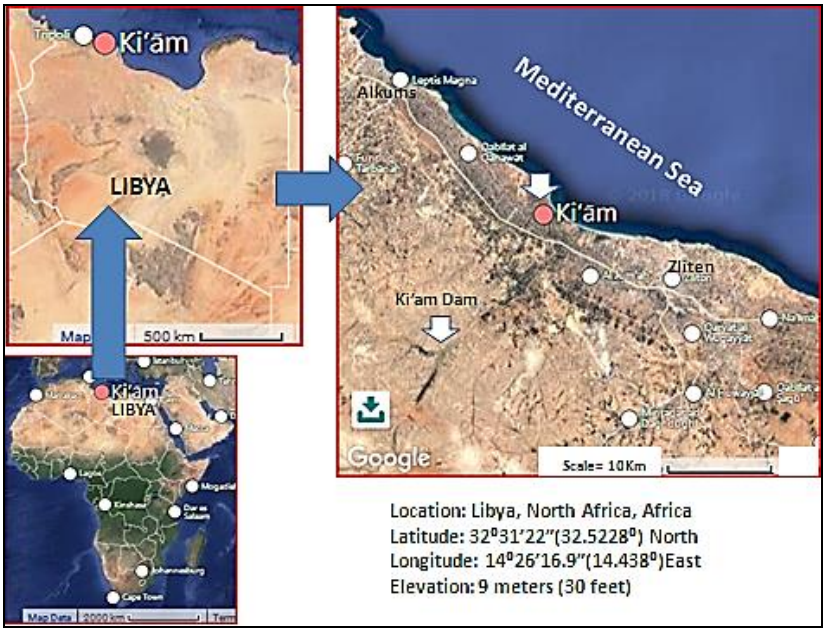


Fig (1) Location of study area : (Google : mapcarta.com, 2018)

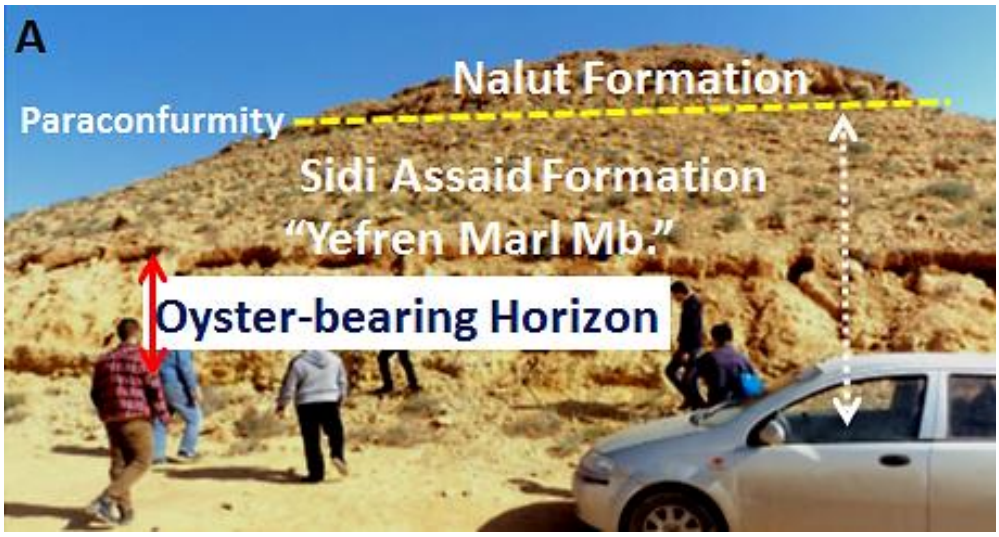
Some geological aspects of the area of study has been studied recently by (Ismail F. Shushan & Mohamed Abdeljalil, 2017).

1-2 Aims of the Study

The present research aims to document the oyster fossils encountered in the clayey-marl horizon of Sidi Assed Formation at Wadi Ka'am area. Moreover, the research is also intending to compare the fossil species from the study area with such similar oyster fossil species encountered in Tethyan outcrops deposited during Cretaceous.

1-3 Methodology

Field and lab investigations were necessary to fulfill the scope of this research. Several steps include: 1- Cautious removal and collection of encountered fossil bodies, 2-, Cleaning and separation, 3- Documentation, description and sorting of the preserved parts, 4- Fossil species comparison. The following field photos were taken during research investigations (Fig-2A, 2B, 2C).



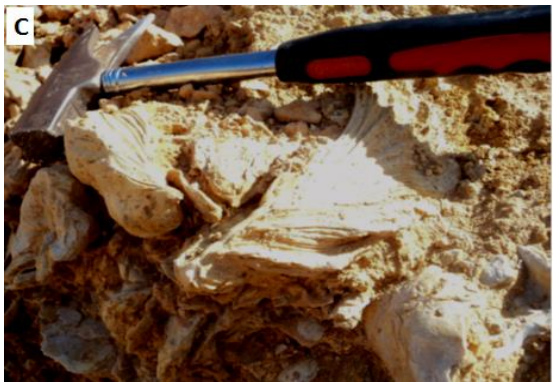


Fig (2): (A): Shows the contact (yellow dashed line) between Sidi Assed Fm. (down) & Nalut Fm. (up) as well as the oyster-bearing horizon within Yefren Marl Mb. (B,C): Shows close-up views of parts of the preserved oyster body fossils within Yefren Marl Member.

1-4 Stratigraphy of Study Area

The stratigraphic succession of study area actually forms a part of Al-Khoms area which has been presented by Mann (1974). Table (1) summarizes the stratigraphy of the study area. The succession of Late Cretaceous is presented in Fig (4) to show the position of the Oyster-bearing horizon which is the subject of this study within the succession.

Table (1) The stratigraphic succession of Al-Khoms and adjacent areas (After Mann, 1975)

AGE	FORMATION	MEMBER	THICKNESS(m)	DESCRIRTION
QUATERNA	Recent Valley Deposits	-	-	Grevels and boulders
	Eolian Deposits	-	10-20	Coastal calcareous sandstones
	Eoilian Marine Deposits	-	10	Eolian materials intercalated with gravels & rare calcareous shells
	Sabkha Deposits	-	1-3	Clay & sandy limestone associated with salt & gypsum crystals
	Qargaresh	-	30-40	Calcarenite with sporadic siltstone lenses
	Jefara	-	15	Siltstone & conglomeratic sandstone with calcareous & gypsiferous shells
				Consolidated & loose

R Y	Qasar Al-Haj	-	25	gravel with intercalcations of calcareous shells
MIO-CENE	Alkhoms	-	100	Limestone, marly-limestone, conglomerate, sandy-calcarenite, clay
LATE-CRETACEOUS	Nalut	-	200	Dolomitic limestone to dolomite with chert nodules
	Sidi Assed	Yefren Marl	380	Marl, claystone with gypsum crystals & oysters
		Ain Tobi	30-45	Dolomitic limestone to dolomite with quartz & quartzite interbeddings
TRIA-SSIC	Abu Shaybah	-	150-160	Sandstone & mudstone interbedded with calcareous beds & conglomerate

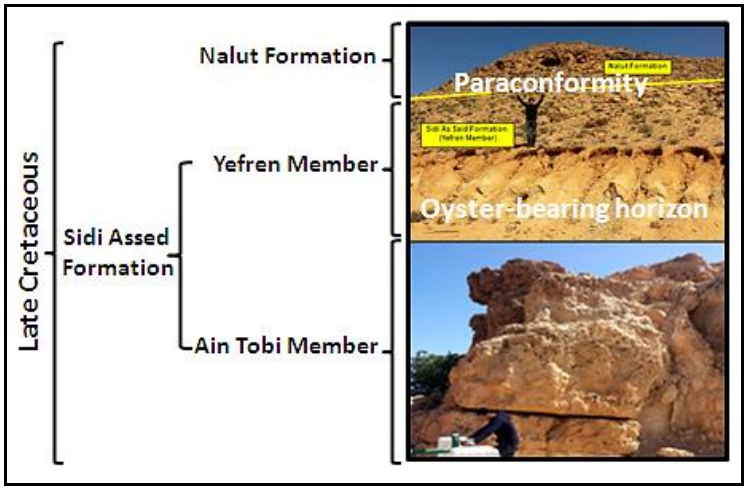


Fig (4) Summary of Late Cretaceous succession encountered in the study area (modified from Ismail F. Shushan & Mohamed Abdeljalil, 2017).

1-5 Study of Oyster Fossils in Wadi Ka'am Area

1-5-1 General Principles

The sallow Tethyan outcrops is characterized by the presence of a great numbers of oysters from Peru over Morocco to Egypt, and may extend to Central Asia, which many of specialists considered them as a typical feature in this region (Dhondt et.al, 1999).

In North Africa, during the Cretaceous, oysters typically inhabited shallow-water environments of the shelf seas bordering the Tethys. They first appeared in the late Aptian (in Algeria and Morocco) and formed specific facies since the Cenomanian (Dhondt et al. 1999).

Oysters make part of invertebrate animals that neither possess nor develop a vertebral column (commonly known as a backbone or spine) *(Brusca, Richard C.; Brusca, Gary J. (1990).* Oysters may belong to the Kinkdom "Animalia", Phylum "Mollusca" and the Class "Bivalvia". Bivalvia is a class of marine and freshwater molluscs that have laterally compressed bodies enclosed by a shell consisting of two hinged parts. Oyster is the common name of a number of different families of salt-water bivalve molluscs that live in marine or brakish habitats. In some species the valves are highly calcified, and many are somewhat irregular in shape. The word "oyster" comes from Old French oister, in turn from Latin ostrea, the feminine form of ostreum which is the latinisation of the Greek (Ostreon)"oyster". The shell of bivalve molluscs is characterized by two calcareous halves, called valves, which can be composed of either calcite and/or aragonite. Some groups, such as the oysters, are exclusively calcitic, while others, such as the pterioids, have an aragonitic inner layer. Many researchers studied and described the bivalaia class and offered lots of information which are applicable to any paleontological studies concerning this type of fossils. among these are: (Boardman, Richard S., Cheetham, Alan H. & Rowell, Albert J. 1987, Clarkson, E. N. K. 1986, 1987, 2000, McRoberts , 2011, Boardman et.al., 2012, Ragaini, L e.t al., 2002).

1-5-2 Description of Oyster Fossils in the Study Area

In this current research, several criteria were used to describe the different Oyster fossils found in Wadi Ka'am area, this include: 1- Valve orientation, 2- Shape of the shell, 3- Identity of valves (symmetry), 4- The hinge line and the hinge plate, 5- Dentition (teeth pattern), 6- Musculature (muscle construction), 7- Ornamentations. 8- Direction and degree of curvature of the shell beaks.

1-5-2-1 Valve Orientation: The left valve is the larger of the two and is the valve that is cemented to the substratum. It is deeper than the right and forms a cup that supports the mollusk, while the right valve is smaller and flatter, forming a cover that fits over the cup of the left valve. The broad end of the shell is called "ventral side" while the narrower one is called "dorsal side" (Boardman et.al., 2012 and Clarkson, E. N. K. 1986). In the lab the right and left valves can be also oriented according to their position from the shell axes while the valve is attached to a hand (Fig-5, Fig-6).

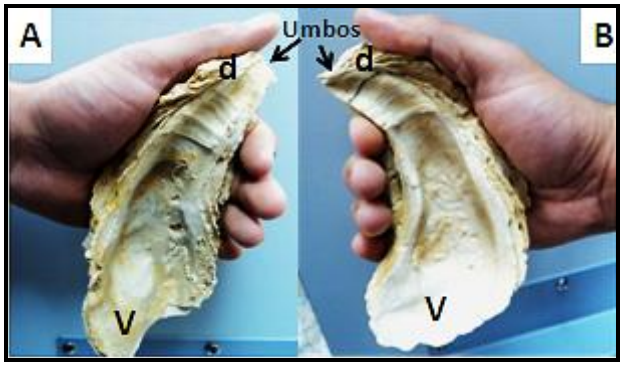


Fig (5) Shows valve orientation of oyster fossils in the area of study. Note the forward orientation of the thumb finger. (A): right valve. Note the smaller size, the less depth & flattens characters as well as the dorsal "d" (narrow) and ventral "v" (broad) sides. (B): left valve. Note the cuplike, the larger size, & the deeper characters as well as the dorsal "d" (narrow) and ventral "v" (broad) sides.

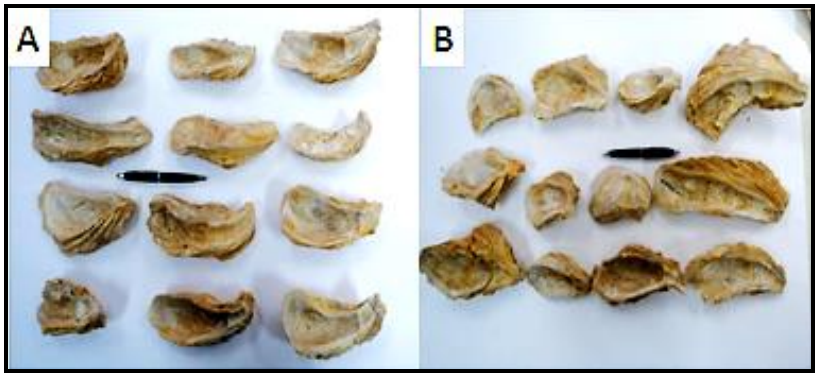


Fig (6) Examples of left (A) and right (B) valves of Oyster fossils within the Oyster-bearing horizon of Sidi Assed Formation in Wadi Ka'am Area-Libya.

1-5-2-2 The shape of the shell: Several shapes of the Oyster fossils are encountered in the study area. They include rounded, sub-rounded to oval, long slender to cylindrical, triangular to fan-shaped and wing shapes (Fig- 7 & Fig-8).

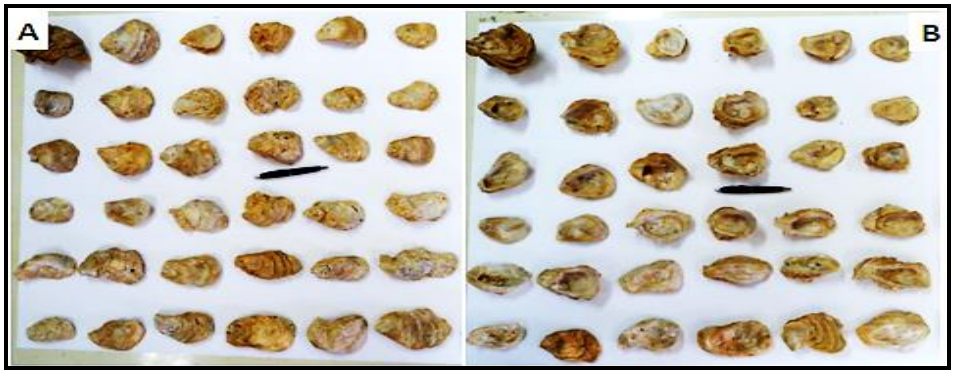


Fig (7) Examples of rounded and sub-rounded to oval valves of Oyster fossil found within the Oyster-bearing horizon of Sidi Assed Formation in Wadi Ka'am area. A: (exterior) & B: (interior).

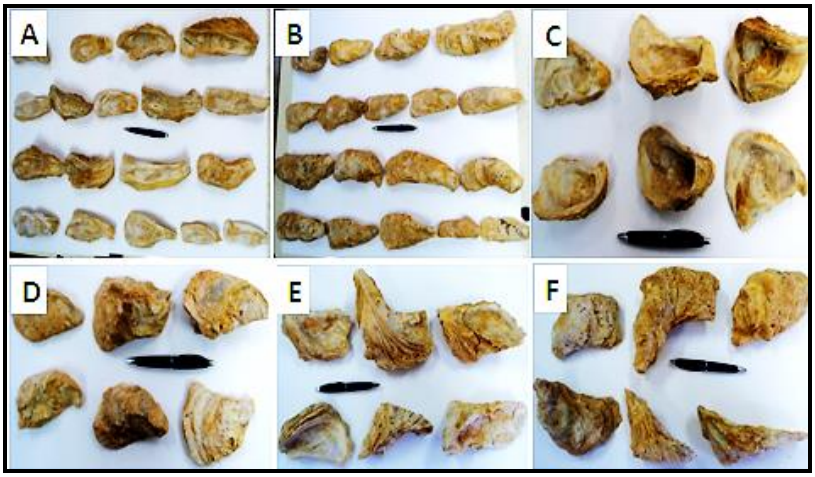


Fig (8) Examples of valve shapes of Oyster fossils in Wadi Khaam area. Long slender to cylindrical (A & B), triangular to fan-shaped (C & D) and wing-shaped (E & F). A,C & E: represent interior parts while, B,D & F: are exterior parts.

1-5-2-3 Identity of valves "Symmetry" : Oysters are inequivalve bivalves with a shell composed of two unequal valves **(**Boardman et.al., 2012 and Clarkson, E. N. K. 1986**)**. Likewise, Oysters found in the study area were inequivalve and are bilaterally inequivalent "inequilateral" (Fig-9).

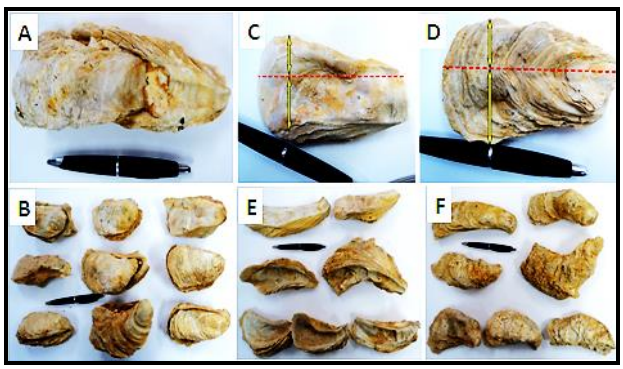


Fig (9) Valve Symmetry of oyster fossils found in study area. (A & B): are examples of inequivalve Oyster shells, (C,D,E & F): are examples of bilaterally inequivalent oyster valves (inequilateral).

1-5-2-4 Hinge line and hinge plate character

ristics: The two valves are joined to each other by a hinge at the dorsal end (Fig 2). An internal protein hinge ligament (or hinge line) in the hinge holds the two valves together. The internal surface parallel to hinge line which holds a teeth (hinge teeth) is called the hinge plate. The pointed **umbo**, or beak, of each valve extends dorsally beyond the hinge. The tip of the umbo is the oldest part of the shell **(**Boardman et.al., 2012 and Clarkson, E. N. K. 1986**).** This current study of Oysters in Wadi Khaam area revealed that the hinge line shape or appearance varied between elongate, curved and triangular (Fig-10), as well, the hinge plate width has varied between narrow, moderate and large (Fig-11).

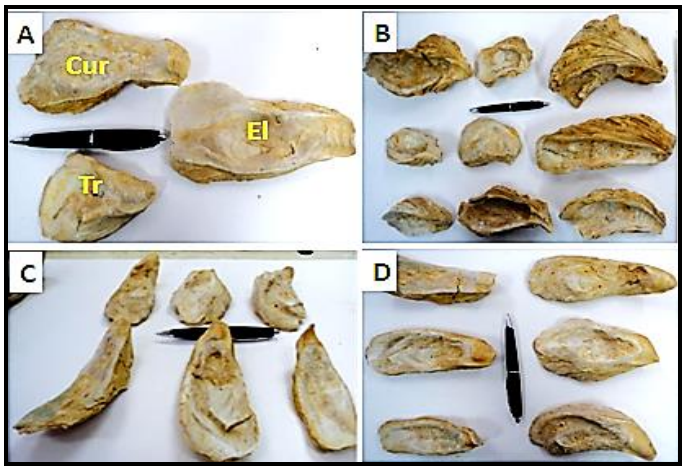


Fig (10) The hinge line shape categories that characterize Oyster shells in Wadi Ka'am area. Cur = Curved, El = Elongate, Tr = Triangular as indicated in "A". (B,C & D) are other examples.

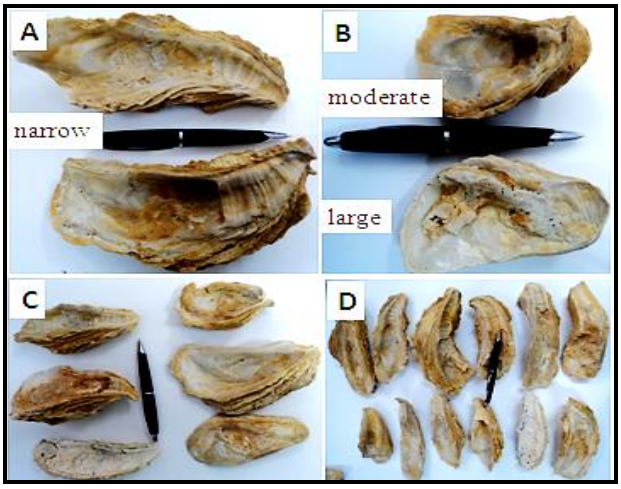


Fig (11) The changes in width of hinge plate zone of oyster fossils found in Wadi Khaam area. A: narrow, B: moderate & large. C & D, another examples.

1-5-2-5 Dentition "Teeth pattern": Teeth are elevated structures mounted on the hinge plate zone of a valve which inter in sockets on the other valve within a bivalve shell. There are two major types of teeth, "cardinal teeth" which lie directly beneath the beak of the valve and the "lateral teeth" which lie away from the cardinal ones. Teeth may contrast in size, morphology, number and their location and hence, they got several terms (Boardman et.al., 2012 and Clarkson, E. N. K. 1986). In this current study, Oyster fossils encountered in Wadi Khaam area possess generally three types of teeth patterns; "schizodont", "dysodont" and "pachydont" (Fig-12).

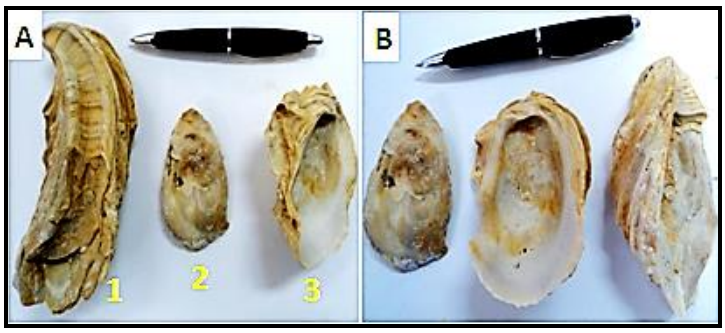


Fig (12) The three types of teeth pattern (dentition) that characterize Oyster fossils found in Wadi Ka'am area. 1= "pachydont", 2= "dysodont", 3= "schizodont".

1-5-2-6 Musculature (muscle construction): The adductor muscles are the main muscular system in bivalve mollusks. the adductor muscles are the only part of the soft parts of the animal which are eaten. Adductor muscles leave noticeable scars or marks on the interior of the shell's valves. Those marks (known as adductor muscle scars) are often used by scientists who are in the process of identifying empty shells to determine their correct taxonomic placement. Bivalve mollusks generally have either one or two adductor muscles. The muscles are strong enough to close the valves of the shell when they contract, and they are what enable the animal to close its valves tightly when necessary, such as when the bivalve is exposed to the air by low water levels, or when it is attacked by a predator. Most bivalve species have two adductor muscles, which are located on the anterior and posterior sides of the body (Boardman et.al., 2012 and Clarkson, E. N. K. 1986). Some families of bivalves have only one adductor muscle, or rarely even three adductor muscles (Huber, Markus 2010). Depending on the number (one or two) and size (equal or not) of adductor muscles of the bivalve shell, such scientific terms are used; ex: "

Dimyrian, Monomyrian, Isomyrian and Anisomyrian". In this current study, Oyster fossils from Wadi Ka'am area showed the dominance of one adductor muscle shells which is the " Monomyrian" (Fig-13).

1-5-2-7 Shell decoration: growth rugae, also growth lines: Irregular ridges or undulations on the shell surface determined by former positions of the outer lip which show slowed or stopped growth. In oysters the shell is built up layer by thin layer. Shell growth is not continuous but interrupted. In warm weather, when food is abundant, growth is faster than in cold weather with a poor nutrient supply. Reproduction and extreme climatic conditions slow down growth too – although it never really stops, just gets very slow. Likewise, Oysters in the area of study showed similar grown ribs-like or costa-like or foliated structures (Fig- 14).

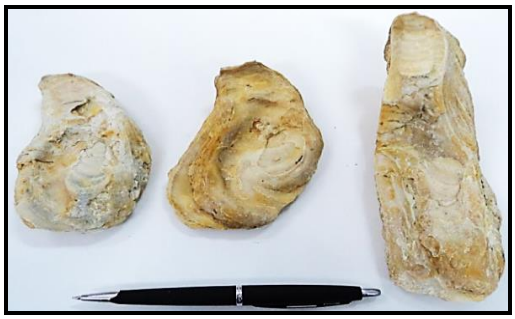


Fig (13) Monomyrian" shells that dominate Oyster fossils in Wadi Ka'am area.

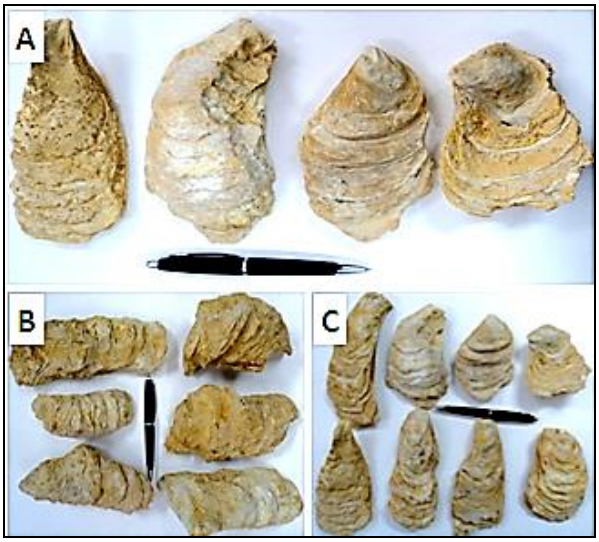


Fig (14) Differences in growth line and ornamentation (rugae) styles of Oyster fossils in Wadi Ka'am area, Libya (as shown in A, B and C). (generally ribs-like or costa-like "foliated" structures).

1-5-2-8 Direction and degree of curvature of the shell beaks: Based on observations made on oyster shell fossils within study area, four categories of beak shapes at least are distinguished (Table-2).

Table-2 The four categories of beak shapes that characterize oyster fossils in Wadi Ka'am area.

Category Nr.	Description	Predominance
1	Narrow, short & straight to slightly curved	common
2	Medium width pointed forward	rare
3	Strongly curved	Very rare
4	Very broad & slightly curved	Very rare

2- Oyster shell comparison:

For better understanding of the oyster fossil species encountered in Wadi Ka'am Dam Area, we better mention a brief notes about oyster fossil species within the North Africa and Mediterranean Sea regions reported by Dhondt et.al, (1999). Many oyster species have been denoted and reported by a number of authors and among those authors was (Lamarck, 1801) who described "Gryphaea africana" which called today "Ilymatogyra africana [afrogyra]" which probably collected from Algeria and of Cenomanian age. Later, similar oyster species have been also reported from southern Italy and in the Near East. Later, oyster faunas have been described from the following places : from Tunisia {see Dhondt et. al., 1999}, from Cirenaaica & Tripolitania { see Dhondt et. al., 1999 }, from Egypt {Fourtau, 1904, 1917}, from Palestine { see Dhondt et. al., 1999}, from Tadjikistan in Central Asia { see Dhondt et. al., 1999}, from Sicily and Calabria { see Dhondt et. al., 1999}.

Dhondt et.al., (1999), noted that Rossi Ronchetti & Albanesi, (1961) studied oyster fossils collected by Desio in western Libya belonging to Cenomanian age. The faunas consists of: Rastellum sp, Ceratostreon flabellatum, Ilymatogyra africana, Laevigyra obliquata, Rh. Suborbiculatum S.S., Costagyra olisiponeizsis, Curvostrea rouvillei and probably Gyrostrea delettrei.

The following is a comparison of oyster fossil fauna documented from Wadi Ka'am Dam Area with oyster fossil fauna from other countries from Mediterranean Sea and North Africa regions (Table-3).

3- Discussion and Conclusions

The oyster fossil species encountered in the clayey-marl bed from Sidi Assed Formation in Wadi Ka'am area showed different morphologic and structure characteristics. Certain general relationships between the shape of oyster shell and the environment has been recorded in many studies (ex : Ostreid Pleistocene fossils from Ecuador by : Rgaini & Celma, 2009) and many others. It is noted that oysters tend to develop round-shaped shells decorated with radial and foliated ridges in case when they growing single on firm bottoms (stable or well-attached). While specimens living as clusters on soft, muddy bottoms tend to develop long-shaped, slender shells which are sparsely ornamented. Oyster species found in the clayey-marl beds in Wadi Ka'am area showed in general at least five categories of shale shapes: rounded, sub-rounded to oval, long slender to cylindrical, triangular and wing shaped. The variety of oyster shale shapes documented at Wadi Ka'am

Fossil Fauna at Wadi Ka'am, Libya	Comparable Fossil Fauna	General Notes
 	   	-Crassostrea virginica Fort Tilden, New York, NY, US. -Ostrea franklini camelina (Cragin, 1888). - Crassostrea gryphoides (Schlotheim, 1813) from the Intertidal of the Florian Layers, Western Styria in Austria. - Crassostrea gryphoides (Schlotheim, 1820) - Ostrea franklini (Coquand, 1862)

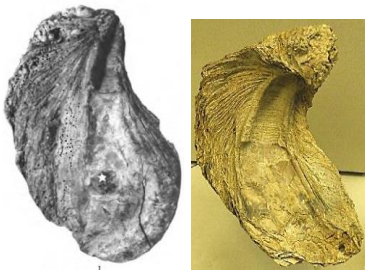
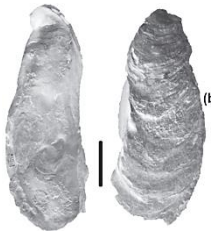
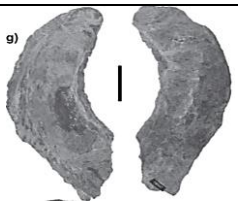
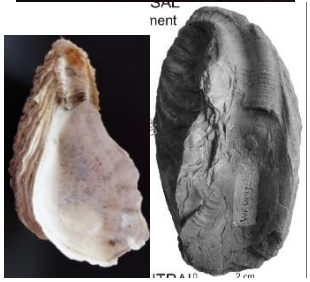
		
		Striostrea? bourgeoisii bourgeoisii (Remond) Hypotype of Clark (1915, pi. 43) UCMP 11566 (x0.5). SanPablo Formation, California. - Crassostrea gryphoides (Schlotheim, 1813) Lorca, Murcia, Spanien. Lorca, Murcia, Spain. Collection: Augsburg Nature Museum Find spot: Lorca / Murcia / Spain
		-***Crassostrea gryphoides*** **(Schlotheim, 1813) from Pacific oyster, Portuguese oyster.**

Table-3 Comparison between Oyster fossil fauna found at Wadi Ka'am area (Libya) and Oyster fossil fauna from Other countries.

		***Crassostrea gryphoides*** **(Schlotheim, 1813) from Siwa Oasis, Western Desert, Egypt.**
	 	***Crassostrea gryphoides*** **(Schlotheim, 1813) from Siwa Oasis, Western Desert, Egypt.** **-*Crassostrea gryphoides* (Schlotheim, 1813) from the Intertidal of the Florian Layers, Western Styria in Austria.**
	 	**- Crassostrea margaritacea (Lamark, 1819).** **-*Crassostrea gryphoides* (Schlotheim, 1813).**
	 	***Crassostrea gryphoides*** **(Schlotheim, 1813), (Laurain, 1980). (SE Turkey) .**

-*Crassostrea gryphoides,* **(Schlotheim, 1813)**

A: (Magdy M. El-Hedeny, 2005)

B: Mathias H. et.al., 2015)

may conclude that they have been lived and survived under strong stable (very-well cemented could be dolomitic) and less stable soft (less dolomitic or non-dolomitic) media bottoms within shallow-water environments (lower shore face to inner shelf). Migration and transportation of bivalve species from place to another (from one medium to another) could take place at any time where one or several species become forced to live with other species in different medium to be survived. Oysters typically grow tightly packed in clumps, or reefs, in which they use each other as substrata for the attachment of the left valve. Because of this crowding the shape of the shell is highly variable (Rgaini & Celma, 2009).

The hinge ligament shape of the oyster fossil species in Wadi Ka'am area showed varied shapes; ex: elongate, triangular and curved to elongate. Rgaini & Celma,(2009) in their study on oysters from Ecuador indicated the triangular and elongate-shaped hinge ligament as “secondary soft-bottom populations”. The variation of teeth patterns of Wadi Ka'am oysters as " schizodont, dysodont and pachydont" could give signs to the enforcement of these oyster populations for living in a mutual place. The dominance of ”Monomyrian" adductor muscle for the oyster population within the area of study could imply the integrated mode of their taxonomic placement. The ribs-like or foliated-like structures growth lines shown on oyster shells in Wadi Ka'am area was evident and may reflect the fluctuation of periods of warm weather with high food supply and periods of less warm (cold) weather with less food supply. The direction and degree of curvature of beaks of oyster shells showed varied categories among which, the narrow, short and straight to slightly curved category was dominant, this is could implicated to the type of substrate

growth (usually formed in oysters which grow on soft، muddy bottoms. The occurrence of several conjoined specimens, most of which randomly oriented, suggests that the short high-energy events during which oysters were tilted and re-oriented were followed by longer periods of low-energy conditions characterized by reduced background sedimentation (Ragaini et al., 2009).

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RADON CONCENTRATION DUE TO ALPHA CONTRIBUTION EFFECTS OF SOIL AND ROCK SAMPLES IN DIFFERENT WEST AND MIDLIBYAN REGIONS

تركيز الرادون الناتج عن مساهمة إشعاع ألفا لعينات التربة والصخور فى مناطق مختلفة من غرب وو سط ليبيا

عبد السلام عبد القادر القطاوى — كلية التقنية الإلكترونية –طرابلس
على مسعود المنصورى — كلية العلوم و التقنيات الطبية /طرابلس
هناء ابراهيم منصور الصويعي — كلية التربية جنزور/جامعة طرابلس.

الملخَّـــص

فى هذا العمل بإستخدام كاشف(HPG_e) – كاشف الجرمانيوم عالى النقاوة- تم حساب تركيز النشاط الإشعاعى الطبيعى لعينات التربة لمناطق الوسط والغرب الليبى ؛ حيث كان متوسط تركيز كل من :- راديوم - 226 (^{226}Ra) - ثوريوم- 232 (^{232}Th) وبوتاسيوم -40 (^{40}K) وكانت الدراسة لعشر مناطق بمتوسط : **(51.86±7.14Bq/kg, 75.56±10.95Bq/kg, 128.89±6.88Bq/kg)** على الترتيب من اليسار إلى اليمين .

كل النتائج المُتحصل عليها بالنسبة للراديوم والثوريوم تفوق المستوى العالمى ، بينما فى البوتاسيوم أقل من المستوى العالمى.

متوسط الجرعة الممتصة خارج المنازل وتأثير الجرعة السنوية الناتجة عن كل من , (^{226}Ra, ^{232}Th, ^{40}k) تم حسابهما فكانتا (21.51±2.93nGy/h, 0.297±0.03 mSv/y) على الترتيب من اليسار إلى اليمين.

دلت الدراسة فى هذا العمل أن مكافئ الراديوم والمخاطر الخارجية أقل من المتوسط العالمى.

ABSTRACT

The activity concentration of natural radioactivity for soil samples collected from western and mid Libyan regions were measured using HPGe detector. The average activity concentration of ^{226}Ra, ^{232}Th and ^{40}K for ten samples were found to be 51.86±7.14, 75.56±10.95 and 128.98±6.88 Bq/kg respectively. ^{235}U was Odetected for six samples with average activity 8.6±1.0 Bq/kg. The results obtained for the corresponding nuclides ^{226}Ra and ^{232}Th are above worldwide average values (35 and 30 Bq/kg) while ^{40}K was smaller than worldwide average (400 Bq/kg). The average outdoor absorbed dose and the annual effective dose rates due to ^{226}Ra, ^{232}Th and ^{40}K were observed to be 21.51±2.93 nGy/h and 0.297±.03 mSv/y respectively, which are lower than world average values (60nGy/h and 0.8 mSv/y). The radium equivalent activity and external hazard indices were found less than the world wide average values.

Keywords: Activity concentration, Absorbed Dose, Effective Dose, World average Activity values, Soil samples, Gamma spectroscopy, Western and Mid Libya

INTRODUCTION

The knowledge of radionuclides distribution and radiation levels in the environment is important for assessing the effects of radiation exposure due to both terrestrial and extraterrestrial sources. Natural background radiation is of terrestrial and extraterrestrial origin. Terrestrial radiation is due to radioactive nuclides present in varying amounts in rocks, building materials, water, soils and atmosphere. Natural radionuclides of uranium ^{238}U, thorium ^{232}Th and potassium

^{40}K are present in the earth's crust. When these radionuclides and their daughters in the series undergo decays gamma rays, beta and alpha radiations are released to the environment. Therefore, human beings are continuously exposed to ionizing radiation both inside and outside their dwellings. People ingest and inhale radionuclides through their food, air and water. The gamma ray exposure in room is due to radiation emitted decay products of ^{226}Ra, ^{232}Th series and ^{40}K. Human has always been exposed to natural radiation arising from the earth as well as from outside the earth [1,2 and 3] Natural environmental radioactivity and the related external exposure due to gamma radiation depend mainly on the geological and geographical conditions, and appear at different levels in the soils of each region in the world. Every building construction material contains different quantities of natural radioactive nuclides. Radiation exposure due to building materials can be divided into external and internal exposure. The external exposure is caused by direct gamma radiation whereas internal exposure is caused by the inhalation of radon (^{222}Rn), thoron (^{220}Rn) and their short-lived decay products. As, radon is a noble gas, it can transport easily through porous media for instance building materials, while usually only a fraction of that produced in the material reaches the surface and enters the indoor air.

The natural radioactivity in the environment is the main source of radiation exposure for human body. Natural radionuclide in soil contributes a significant amount of background radiation exposure to the population through inhalation and ingestion. It can be also transferred to plants and foods and drinking water.

According to A.L.A.R.A, principle, the radium equivalent Raeq, the external hazard index Hex, the

Absorbed Dose Rate A.D.R and the Annual Effective Dose Equivalent A.E.D.E were estimated and compared with results of other studies and with the worldwide average value.

This work was undertaken to measure the activity concentrations and γ-ray absorbed doses of the naturally occurring radionuclides in soil samples. Another aim of this work is to create the public awareness about the radiation hazards and it will also be helpful to establish a research base line in the investigated regions. Some previous studies of Libyan soil, Arab and neighbors' countries soil are summarized and tabulated in Table (1).

The samples were collected, as shown in map represented, in Figure (1), at depth 1-10cm. Samples were treated thermally at 60 0C for 24 hours after that they were sieved to obtain uniform particle size about 550μm then the soil will filled in beaker which was sealed and then weighted and stored for a month to each the secular equilibrium.

Table. 1 Represents the mean and range of activity concentrations in Bq/kg of radionuclides for different countries.

Item	Mean activity concentration Bq/kg (range)			
	^{226}Ra	^{232}Th	^{40}K	country
1	7.5(4-13.5)	4.2(2.8-6.7)	27.5(19-39.6)	Libya, [4] Beach sand of Tripoli -2008
2	(58.8-102.1)			Libya, [5] Aljabel.Al.Gharbi-2011 Using Portable Nuclear Radiation Detector
3				Libya,[6]Northwestern,2001
4	26.02 (17.09-34.03)	30(11-64)	400(140-850)	Iraq, [7]kurkukoil field 2006
5	20.05 (10.87-30.94)	16.43(6.78-20.61)	216.69(127.74-272.7)	Qatar state [8]soil in Dukhan oil field 2015
6	22.03 (1.8-76.4)	27.91(6.3-85.5)	285.0(84-516.7)	Jordan, [9]soil in Tafilla2012
7	16 (46-115)	10	370	Kuwait[10]before war After war
8	(32.2-63.7) (5-13.8)	(44.3-95.6) (2.3-15.3)	(96-102) (29-582)	Egypt, [11],Beach sand Dune
9	30(2-110)	25(2-140)	370 (66-1150)	Algeria,[12]
10	23 (10-64)	20 (10-32)	270 (78-780)	Syria , [13],phosphate rocks
11	12.9 (0.15-41)	6.98 (4.21-9.92)	278 (167.79-419.52)	Nigeria, [14],Akuk,Ondo state

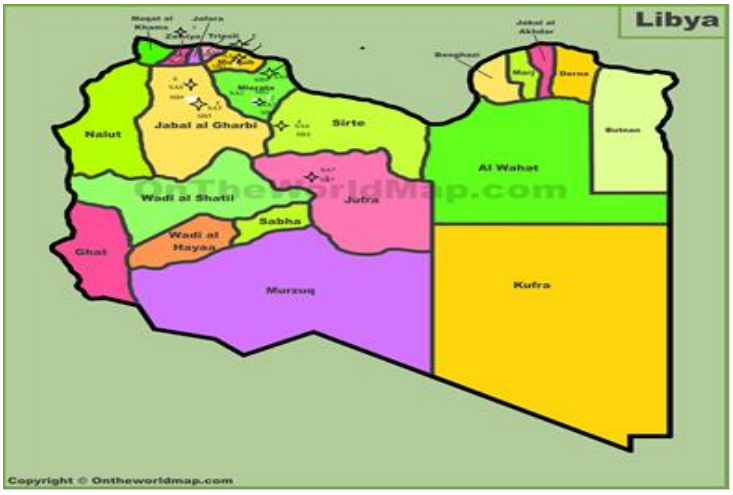


Figure 1: Distribution of selected Samples on Map of Libya Table. 2 indicates Latitude and Longitude

MATERIALS AND METHODS

Sample Collection and Preparation

The samples are selected from different geographic and geological regions in western and mid Libya. Two samples were collected, with masses varied 0.3-

0.53 kg, for each region with separate distance 20 km. The samples information is illustrated in Table 2.

.

Table. 2 Samples information

Samples I.D	Region	Weight (gm)	Type of sample	Sample Location	
				Latitude	Longitude
SA1	Qarabulli	330	Coast	32^0 $44^\backslash$	15^0 $14^\backslash$
SA2	Bu-njim	350	Sand (desert)	30^0 $35^\backslash$	15^0 $24^\backslash$
SA3	Zawia	480	Mountain(stones)	32^0 $45^\backslash$	12^0 $44^\backslash$
SA4	Qaddahea	510	Near the coast	31^0 $22^\backslash$	15^0 $14^\backslash$
SA5	Orban	450	Sand(Oises)	Near Ghrian	Near Ghrian
SA6	Tajoura	300	Sand (desert)	32^0 $53^\backslash$	13^0 $23^\backslash$
SA7	Sokna	530	Coast (near sea)	29^0 $10^\backslash$	16^0 $10^\backslash$
SA8	Ghrian	315	Coast	32^0 $21^\backslash$	15^0 $o8^\backslash$
SA9	Misurata	450	Mountain (stones)	32^0 $25^\backslash$	15^0 $05^\backslash$
SA10	Qaser Akhiar	240	Desert	Near Qarabulli	Near Qarabulli

Gamma-ray Spectrometry

Gamma spectrometry offers a convenient, direct, and non-destructive method to measure the activity of different radionuclides in the environmental samples. It also offers high efficiency Nal(Tl) detectors and high resolution (semiconductor detectors) detection. This technique enables the use of large quantities of samples to be counted. It is also possible, in this method, to reduce the essential background to very low values using suitable shielding arrangement. These advantages together with appropriate ability software (Genie 2000) that have now become available has made the gamma spectrometry method one of the most accurate technique for determining the activity concentration of the environmental samples. In the present work, HPGe gamma spectrometer was used for the determination of gamma active radionuclide in soil and rock samples. NaI(Tl) scintillator and HPGe semiconductor detector are commonly used for the gamma ray spectrometry. Hyper pure germanium detectors are widely used for gamma ray spectroscopy to determine quantitatively the activities of natural ^{40}K, ^{232}Th, ^{226}Ra in the environmental samples. The HPGe detectors have very high resolution, but the efficiencies are low compared to those of scintillation detectors such as Nal(Tl). The high purity germanium detector can be produced from either n-type or p-type (Germanium) semiconductor material. The block diagram of

HPGe gamma ray spectrometer system is shown in Figure (2).The spectrum was analyzed using multichannel analyzer (MCA) connected to computer using Genie-2000 software. The sealed sample was placed in the protection unit of gamma ray spectrometry for the counting time of six hours the energy resolution (FWHM) of this detector is 2.01 keV at 1.33 MeV (^{60}CO).

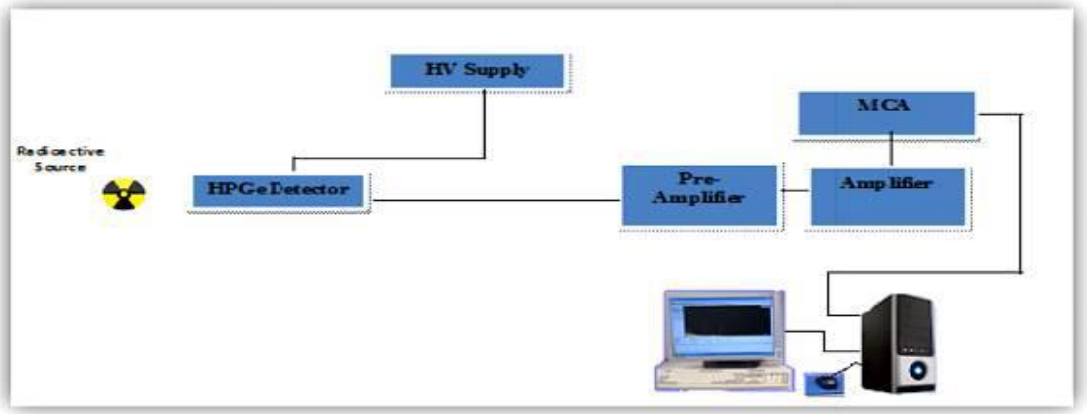


Figure (2): Block diagram of gamma-spectrometer detectors

Calibration of Gamma-ray Spectrometer System

The calibration of the spectrometer system for energy measurements is necessary to know the approximate energies of the radiation source being analyzed. The aim of calibration is to identify the radionuclide and activity concentrations present in an environmental sample. Energy calibration is carried out to confirm linear relationship between energy

and the number of channels corresponding to that energy, and to determine the energy of each channel in a spectrum. The spectrum is obtained for a reasonable time so that the photo peaks have sufficient counts for analysis. The regions of interest and centroid peak channel numbers are identified. Then the slope of the straight line plotted between the

Channel numbers versus energy represents the energy calibration factor. Figure (3) shows the energy calibration curve for HPGe detectors.

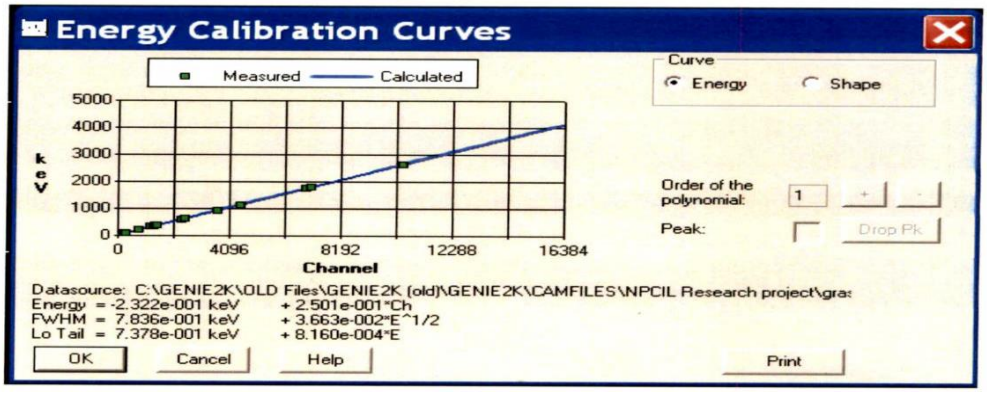


Figure (3): Energy calibration curve for the p-type HPGe detector generated by the Genie-2000 software.

In the present work, the detector efficiency calibration was performed using standard assurance reference materials and standard soil. These standard reference materials were taken in containers similar to the containers used for filling the soil samples for gamma spectrometric determination. The standard materials and samples were taken in containers of the same size and type so that the geometry remained the same. The samples were counted long enough (one week) to reduce the counting error. The variation of efficiency of the detector with energy for different gamma lines of various radionuclides for the p-type HPGe gamma ray spectrometer system used in the present work is shown in Figure (4).

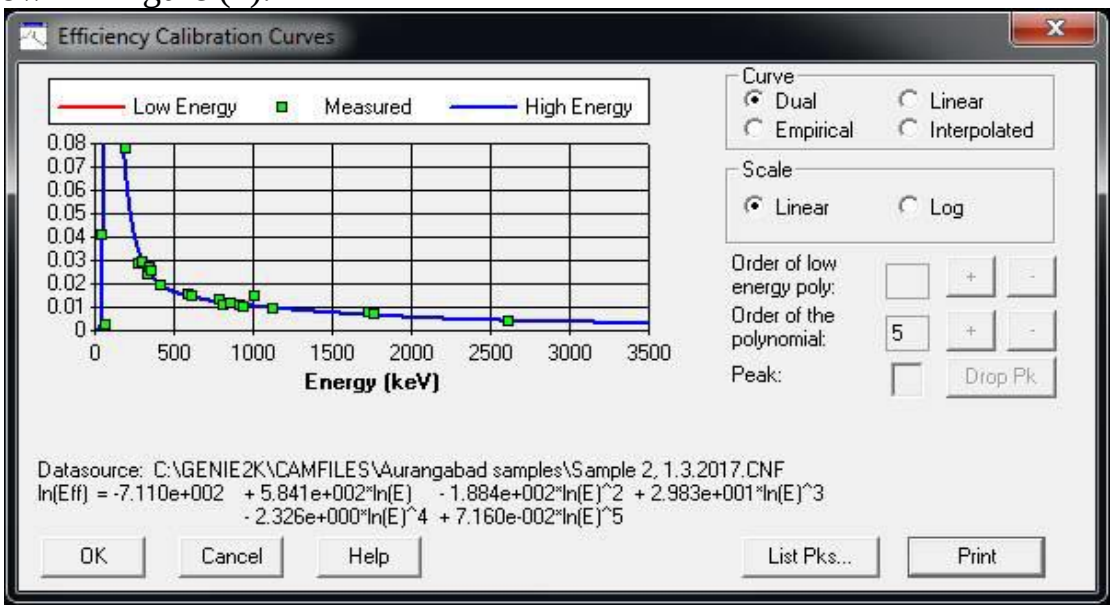


Figure (4): Efficiency calibration curve for the p-type HPGe gamma spectrometer system (as generated using Genie-2000 gamma spectrum analyses software).

Calculation of Activity Concentrations

The radioactivity of each sample was measured with keeping the samples one by one on the top of the detector and counted for a period of one day. The activity concentration (A) of each radionuclide in the sample was determined by using the count rates (N_c) (after subtracting the back ground).

$$A = \frac{N_C}{\varepsilon I_\gamma W} \qquad \textbf{(1)}$$

Where ε =Efficiency of the detector for the specific energy, I_γ= Intensity of the gamma ray and W= Sample weight (kg). For the analysis of peak areas of gamma spectra, a computer software programming (Genie 2000) was used [15]. Determination of NORM were carried out by measuring different daughters that emit clear gamma peaks of high intensity to confirm the attainment of radioactive secular equilibrium within the samples between ^{226}Ra and its daughters. This was carried out by measuring ^{226}Ra directly through the 186.2 keV and indirectly by measuring the ^{214}Bi (609.3, 1120.2 and 1764.5 keV) and ^{214}Pb (351.9 keV) photo peaks. ^{235}U was determined directly through the 143.8 keV photo peak. ^{232}Th was determined through ^{228}Ac (911.2 keV), ^{212}Pb (238.6 keV after subtract 241.2 value) and ^{208}Tl (2614 keV) photo peaks, and estimation of ^{40}K through the 1460.8 keV photo peak. The main radionuclides and specifications are listed in Table (3).

Nuclide to be determined		Nuclide measured	Energy in keV	Probability in %	Half-life time
^{226}Ra		**^{226}Ra**	**186.1**	**3.51**	**1600y**
		^{214}Pb	**295.22**	**18.15**	**26.8 mit**
		^{214}Pb	**351.1**	**35.1**	
		^{214}Bi	**609.31**	**44.6**	**19.9 min**
		^{214}Bi	**1120.22**	**14.7**	
^{232}Th	**^{228}Th**	**^{228}Ac**	**209.25**	**3.89**	**6.13 h**
		^{228}Ac	**338.32**	**11.27**	
		^{228}Ac	**911.2**	**25.8**	
	^{228}Ra	**^{208}Tl**	**583.19**	**30.4**	**307 min**
		^{208}Tl	**860.56**	**4.47**	
		^{208}Tl	**2614.53**	**35.64**	
^{40}K		**^{40}K**	**1460.83**	**10.67**	**1.28×10^9 y**

Table(3) : Natural Radionuclides found in samples and background [16].

Computation of Radiological Effects

Radium equivalent Activity Ra_{eq}

The important radionuclides in nature ^{226}Ra, ^{232}Th and ^{40}K are not uniformly distributed ,this due to disequilibrium between ^{226}Ra and its decay products .For uniformity in exposure, estimates the radionuclide concentrations have been defined in terms of radium equivalent activity (Ra_{eq} in Bq/kg) . This allows comparison of the specific activity of materials (A_{Ra}, A_{Th} and A_K) containing different amounts of ^{226}Ra, ^{232}Th and ^{40}K according to:

$$Ra_{eq}=A_{Ra} + 1.43A_{Th} +0.077A_K \quad (2)$$

External and Internal Hazard Index:

The hazard index (H_{ex}, H_{in}) is the indoor radiation dose rate due to the external/internal exposure gamma radiation construction materials which was calculated by:

$$H_{ex}= 0.0027A_{Ra} + 0.0038\,A_{Th} + \ 2.o8\times10^{-4}A_K \qquad \textbf{(3)}$$
$$H_{in}=0.00541\ A_{Ra} +0.0038\,A_{Th} + \ 2.o8\times10^{-4}A_K$$

Calculation of air absorbed dose rate:

The external outdoor absorbed gamma dose rates due to terrestrial γ-rays from the nuclides of ^{226}Ra, ^{232}Th and ^{40}K at 1m above the ground level was calculated as :-

$$A.D.R=(0.461A_{Ra} +0.623A_{Th} +0.0414A_K\ )\ nGyh^{-1} \qquad (4)$$

About 98% of the external γ dose rate from ^{238}U series is delivered by the ^{226}Ra sub series .So disequilibrium between ^{226}Ra and ^{238}U will not affect the results of dose calculations from the measurement of ^{226}Ra**.** The absorbed dose rate was converted into annual effective dose equivalent by using conversion factor of o.7SvGy and 0.2 for the outdoor occupancy factor by considering that the people on the average spent 20% of the time outdoors.

Effective dose rates:

The Effective dose due to natural activity in soil was calculated by:

$$(A.E.D.E)\ in = 8760\times0.2\times0.7\times10^{-3}A.D.R)\ \mu Svy^{-1} \quad (5)$$

Gamma index (Iγ):

The index (Iγr) is used to estimate the level of γ –radiation hazard associated with the natural radionuclides in specific investigated samples, is defined as :-

$$I_{\gamma r} =0.007A_{Ra}+0.01A_{Th} +6.6\times10^{4}A_K \quad (6)$$

For materials that are used in bulk quantities (Such as clay bricks and concrete etc.), the value of $I\gamma \leq 0.5$ corresponds to a dose rate criterion of 0.3 mSv yr-1 whereas $0.5 < I\gamma \leq 1$ corresponds to a criterion of 1 mSv y^{-1} [17]

Alpha index (Iα):

As radon daughters decay, they emit radioactive α- particles and attach to aerosols, dust and other particles in the air. As persons inhale, radon progeny are deposited on the cells lining the airways where the α- particles can damage DNA and potentially cause lung cancer. The excess α- particles radiation due to radon inhalation originating from building materials is estimated through the α- index (I**α**), which is defined as follows [14]: $I\alpha = \frac{A_{Ra}}{200}$ (7) The recommended upper limit concentration of ^{226}Ra is 200 Bq kg^{-1} which gives Iα= 1.

RESULTS AND DISCUSSION

In this work the activity concentrations and radiological indices of soil samples, taken from different Libyan sites, are summarized. Activity concentrations for nuclides ^{235}U, ^{226}Ra, ^{232}Th and ^{40}K was determined by equation (1) and the results were tabulated in Table (4) and illustrated togather in Figure (5). The highest value is found for sample S10A, for ^{238}U (^{226}Ra) 103.81 Bq/kg, while SA4 for ^{232}Th(153.5Bq/kg) also SA4 for ^{40}K 168.57 Bq/kg). The highest activity, of the nuclide, may vary from place to place due to chemical changes in elements of soil or using agriculture fertilizers or material wastes, weapons etc . The results for these nuclides are also shown independently through Figures. (6-8).

I.D	^{235}U	^{226}Ra	$^{235}U/^{238}U$	^{232}Th	^{40}K	$^{226}Ra/^{232}Th$
S1A	12.33±1.3	74±7.85	0.17	63.00±6.70	146.2±15.16	1.17
S2A	7.47.±0.82	56.83±6.77	0.14	42.96±4.44	131±13.39	0.78
S3A	5.32±0.66	33.06±4.53	0.16	40.74±4.94	146.4±16.2	2.13
S4A	10.79±1.65	60.16±6.52	0.18	153.5±16.47	168.57±17.30	1.56
S5A	7.83±0.76	29.12±5.42	0.27	92.33±8.79	108.57±11.14	1.09
S6A	7.89±0.78	30.09±3.86	0.26	102.3±9.02	116.01±13.24	0.57
S7A	N.D	26.71±5.95	N.D	47.62±6.21	103.44±10.36	1.42
S8A	N.D	33.26±4.49	N.D	46.92±6.36	100.35±9.65	0.71
S9A	N.D	71,6±7.08	N.D	47.7±6.19	140.3±14.52	2.25
S10A	N.D	103.81±11.28	N.D	118.3±11.60	N.D	0.87
Average	8.6±1	51.86±5.14	0.196	75.56±7.36	128.98±12.05	1.305
Max	12.33	103.81	0.27	153.5	168.57	2.25
Min	5.32	26.71	0.14	40.74	100.35	0.57
S.D	0.99	5.14	0.0005	7.36	12.05	0.16

Table (4) The Activities concentrations of the ^{235}U , ^{226}Ra , ^{232}Th and ^{40}K in Bq/kg for the measured samples.

N.D Not Detected

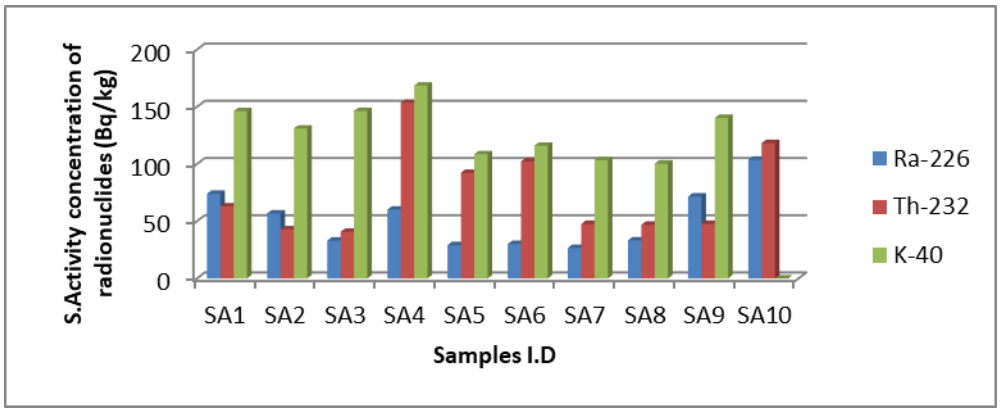


Figure (5):The activity concentration of radionuclides for investigated samples

From Table (3), ^{235}U appears in six regions (labeled from 1 to 6 as illustrated in Figure (6) with high abnormal concentrations (5.32-12.33 Bq/kg) and higher ratio (o.14-0.27) than normal (0.026) as illustrated in Figure (7), the samples were taken from these regions after NATO strikes during sixth months 2011; the type of used weapons has fission nature.

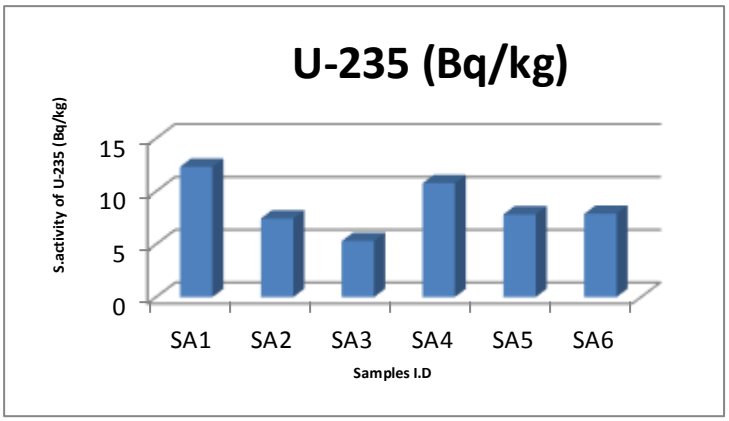


Figure (6): Soil Samples Activity Concentration of ^{235}U

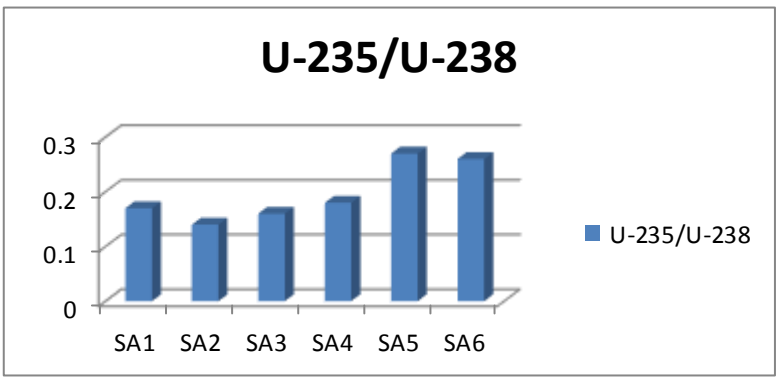
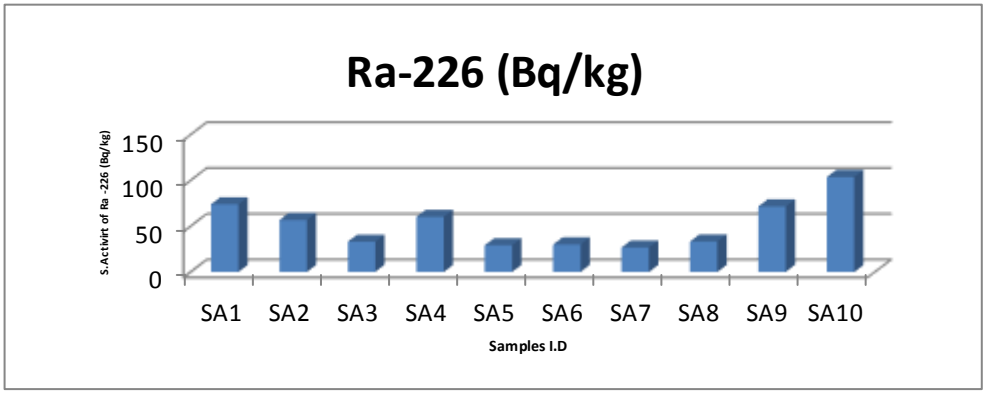


Figure (7) ^{235}U to ^{238}U activity concentration ratio ^{226}Ra *activity*

In soil samples the activity

concentrations of ^{226}Ra were found in the range of 26±0.71-103.8±12.38Bq/kg, with an average value 51.68±7.14 Bq/kg .This result is higher than the world wide average value of 35 Bq/kg for the same radionuclides in soils reported by UNSCEAR.



Figure(8): Soil Samples versus activity concentration of ^{226}Ra radionuclides (^{238}U Series)

^{232}Th Activity

The concentration of ^{232}Th is found in the range 40.74±2.70 - 153.5±7.57 Bq/kg with mean value 75.56±10.95 Bq/kg this result is higher than the world average of 30 Bq/kg. SA1 Qarabulli).The ratio concentration of ^{226}Ra(^{238}U series) to ^{232}Th is less than unity,(concentration of ^{232}Th is higher than ^{226}Ra)

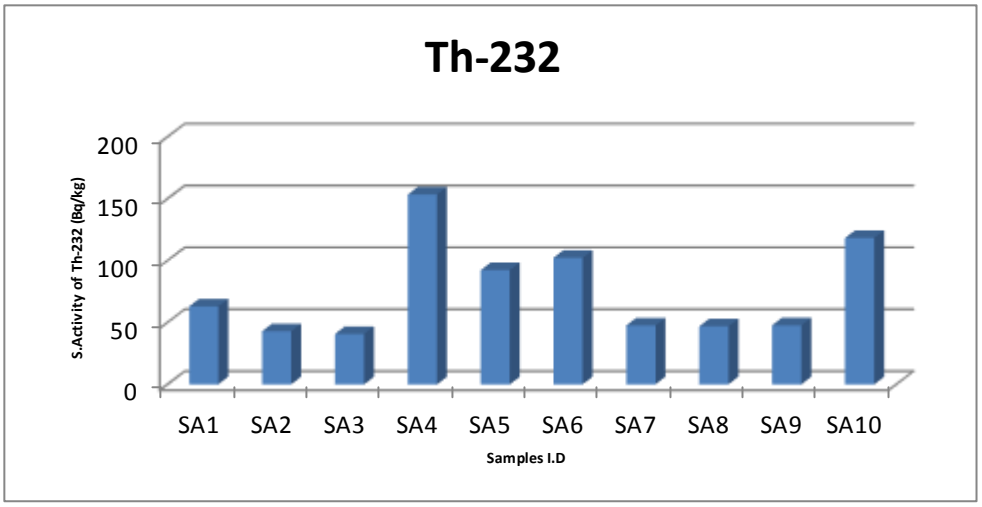


Figure (9): Soil Samples activity concentration of of ^{232}Th series

^{40}K Activity

The activity ^{40}K is found in the range (100.35±4.36) – (168.57±27.26) Bq/kg with the average value of 168.98±6.88 Bq/kg . This result is mostly lower than the world wide average of 400 Bq/kg but SA4 is very high for the same kind of nuclide.

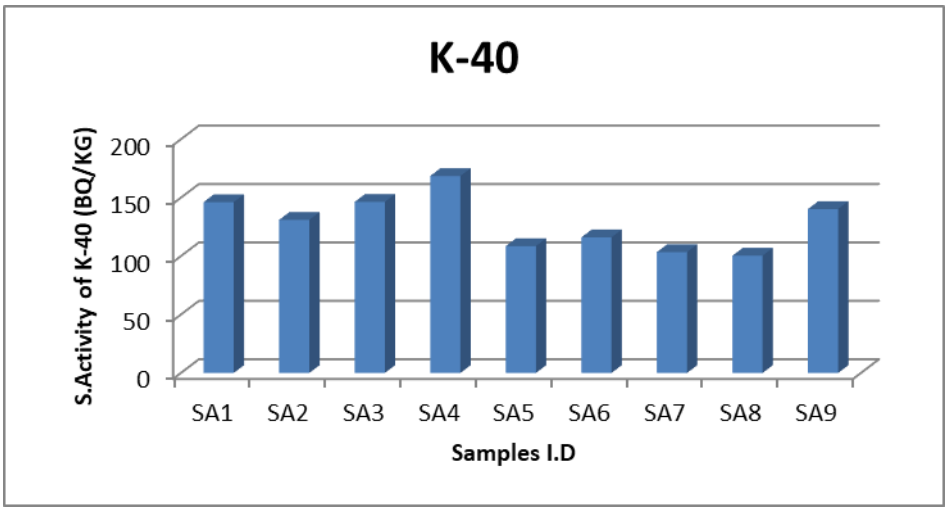


Figure (10): Soil Samples concentration of ^{40}K

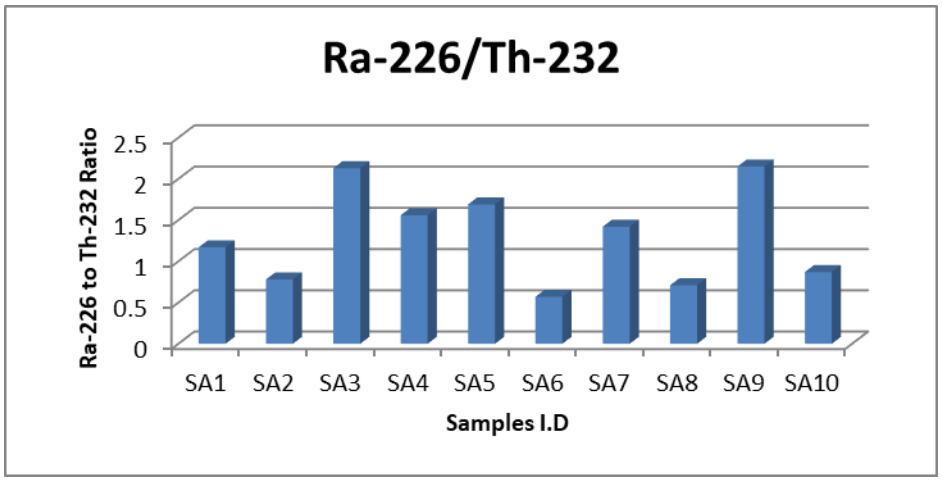


Figure (11): $^{238}U(^{226}Ra)$ to ^{232}Th Activity Ratio

To estimate the health effects ,the radiation hazards such as radium equivalent (Ra_{eq}),external and internal hazard index (H_{ex},H_{in}) ,absorbed dose Rate (A.D.R) ,effective dose rate (AEDE), level index ($I_{\gamma r}$) and α- -index have been calculated from the activity of nuclides ^{226}Ra ,^{232}Th and ^{40}K using the equations (2-6) respectively and the values have shown in Table(5) and Figure.(12-16)

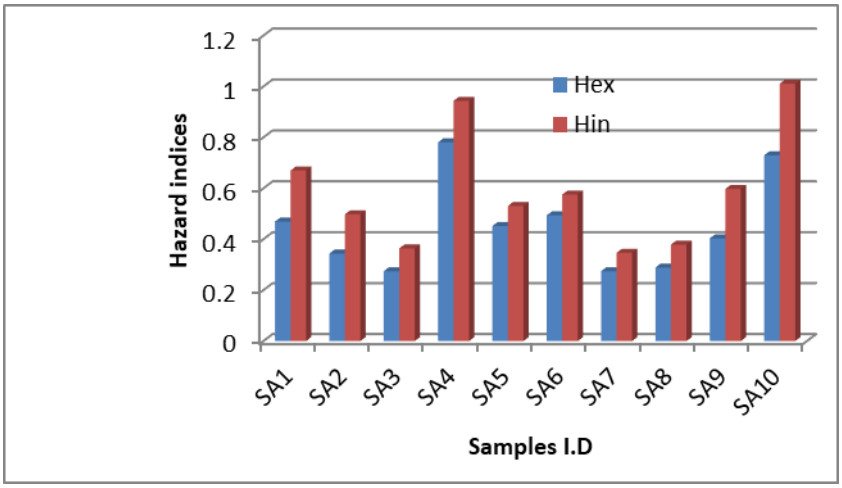


Figure.(12): Radiological Indices of the Investigated Sample (Hazards-Indices)

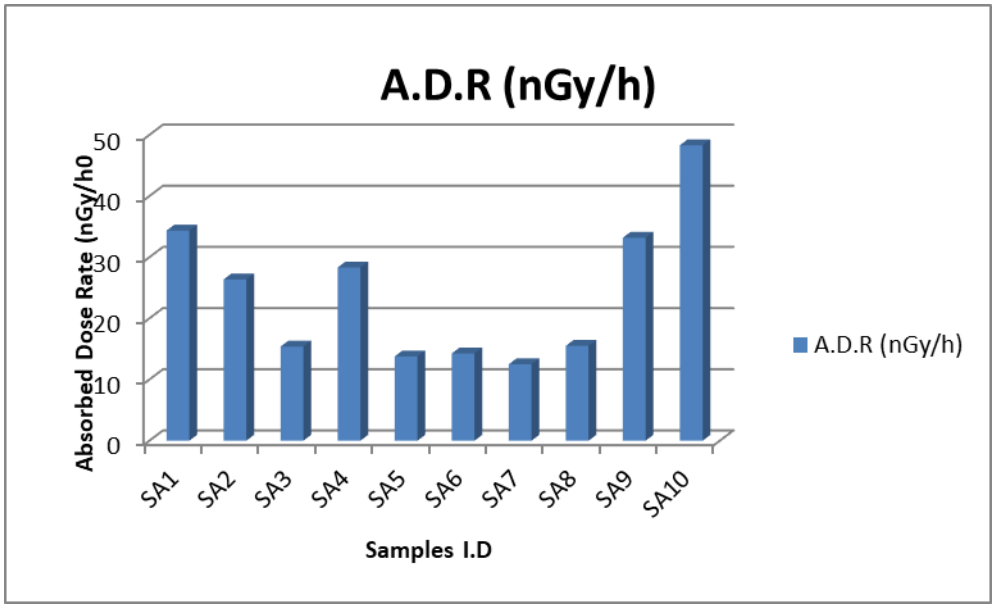


Figure.(13): Radiological Indices of the Investigated Sample (Absorbed Dose)

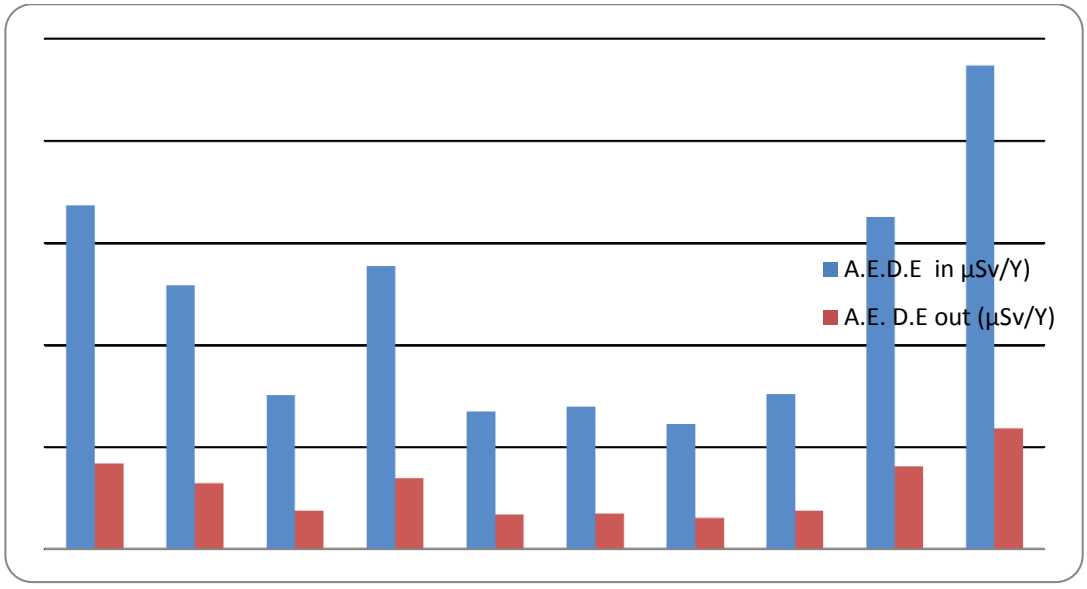


Figure.(14): Radiological Indices of the Investigated Sample (Annual Effective Dose)

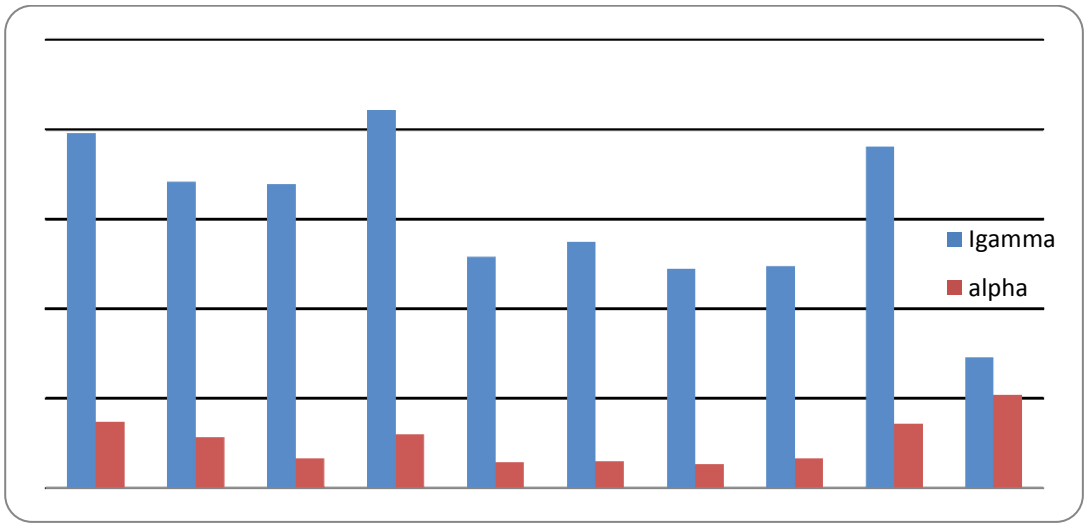


Figure.(15): Radiological Indices of the Investigated Sample ($I_{\gamma r}$ and I_{α} indices)

Table **(5)**, shows that the radium equivalent (Ra_{eq}) is found in the range (102.59±20-292.64±34.33 Bq/kg), and has average value of 157.25±13.18 Bq/kg. The average value of radium equivalent is less than the safe limits 370 Bq/kg[2]. The mean value of external radiation hazard index is (0.45±0.09) which is less than 1 and confirm it as safe to carry out the activities for the human in that region . The outdoor air absorbed dose rate due terrestrial gamma rays at 1m above the ground were calculated for ^{226}Ra ,^{232}Th and ^{40}K and the range is (12.49±1.66) – (34.35±3.76) nGy/h with an average 21.52±2.20 nGy/h which is lower than the world average of 60 nGy/h[2].The annual effective dose rate equivalent is calculated using a conversion factor of 0.7 Sv/Gy to convert the absorbed dose rate to the effective dose equivalent and 0.2 for the outdoor occupancy factor. The annual effective dose rates are found in the range of (153.23±14.50 - 263.89±28.1) µSv/y with an average-e 296.75±29.60 µSv/y which is lower than the world average of 1000µSv/y for the general public (UNSCEAR, 2000).The representative level index $I_{\gamma r}$ equation (6) must be less than unity. For the investigated samples this index is in average 1.52±0.20 Bq/kg, where higher than unity in most samples. Table (5) gives Average activity concentration compared with others.

Table(5). Radium Equivalent Activity (Ra_{eq}), Absorbed Dose Rate (A.D.R),External Hazard Index (H_{ex}), (A..E.D.E) and Representative level index ($I_{\gamma r}$).

I.D	Ra_{eq}(Bq/kg)	A.D.R (n Gy /y)	H_{in}	H_{ex}	A.E.D.E (µ.Ss/y)	$I_{\gamma r}$ (Bq/kg)	I_{α} Index
S.A1	175.34	34.35	0.67	0.469	421.31	1.980	0.37
S.A2	128.34	26.36	0.49	0.34	323.30	1.70	0.28
S.A3.	102.59	15.39	0.36	0.274	188.81	1.69	0.17
S.A4	292.64	28.31	0.94	0.78	347.28	2.10	0.30
S.A5	169.51	13.77	0.53	0.45	168.94	1.28	0.15
S.A6	185.31	14.26	0.57	0.49	174.89	1.37	0.16
S,A7	102.77	12.49	0.34	0.27	153.23	1.22	0.13
S.A8	108.08	15.51	0.37	0.28	190.23	1.23	0.18
S.A9	150.61	33.18	0.59	0.40	407.03	1.90	0.36
S.A10	272.97	48.30	1.011	0.72	592.42	0.72	0.52
Average	157.247	21.51	0.59	0.45	296.74	1.52	0.25
Max.-	292.64	34.35	1.01	0.78	263.89	2.10	0.52
Min.	102.591	12.49	0.34	0.27	153.23	0.72	0.13
S.D	16.05	2.93	0.023	0.027	0.030	0.43	0.096

Table (6) Average activity concentration in this work and others (Bq/kg)

Country	^{238}U	^{232}Th	^{40}K	Ref.
Malizia	39±0.7	52±1	61±15	[18]
Egypt	79±2	44±1	586±18	[19]
Libya	7.5±2.5	6.7±1.9	4.5±1.3	[20]
Iran	74±4	69±4	1130±32	[21]
Turky	70±0.8	83±1	1234±7	[22]
Kenya	12.63-72.51	11.45-58.12	234.8-1058.52	[23]
Nigeria	74.74±5.67	199.23±43.30	1021.27±7.14	[24]
This work	51.86±4.38	75.56±7.36	128.98±12.09	
World wide	33	45	412	[2]

Correlation study:

Correlation analyses were performed to reveal the possible relationship between concentrations of different radionuclides in the samples. The Pearson product-moment correlation matrixes for the correlation coefficient values (R) between the radionuclides activity concentrations were calculated. The correlation between ^{226}Ra &^{232}Th, ^{226}Ra &^{40}K and Radium and absorbed dose in air of soil samples is computed from the concentrations of these radionuclides and shown in figures (16 to 18) respectively. There is a weak correlation between^{226}Ra and ^{232}Th, for the samples (with negative correlation coefficients R= 0.504) in all sampling locations. And there is negative correlation between ^{226}Ra &^{40}K[Correlation coefficient R = -1.43] in samples. The value of correlation between ^{226}Ra and absorbed dose significantly higher with positive correction [correction coefficient R=0.99]

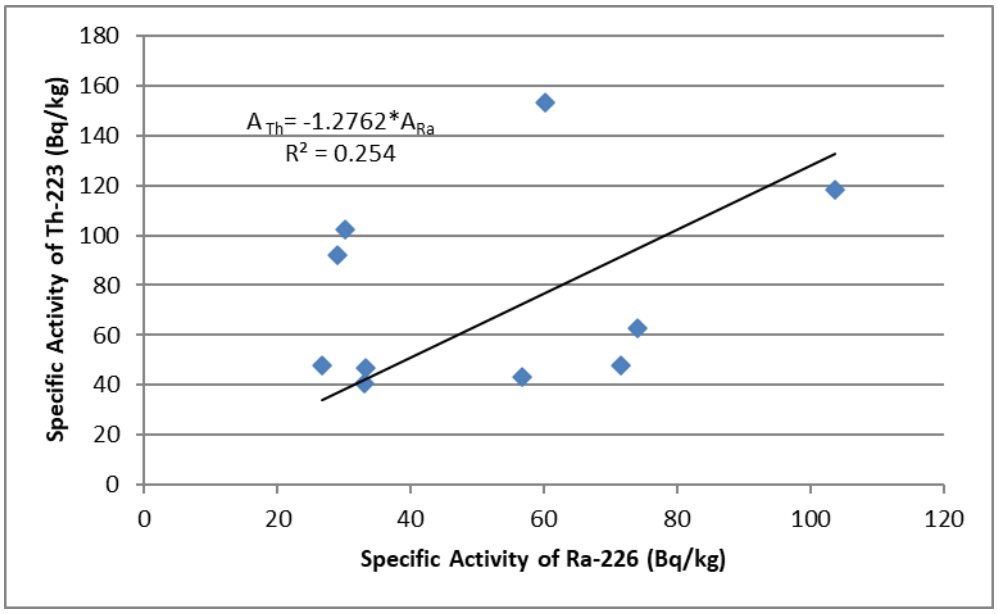


Figure (16): Correlation between Radium and Thorium concentration in Soil samples

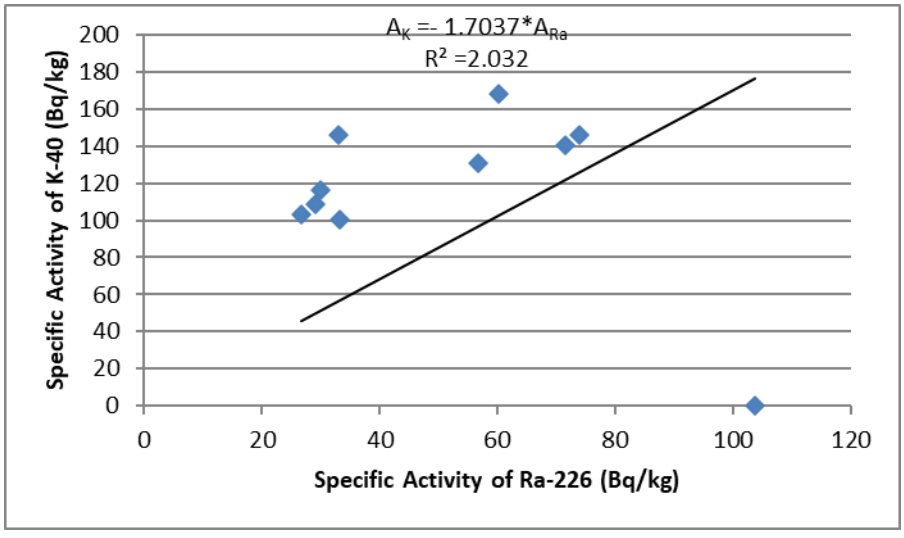


Figure (17) Correlation between Radium and Potassium concentration in Soil samples

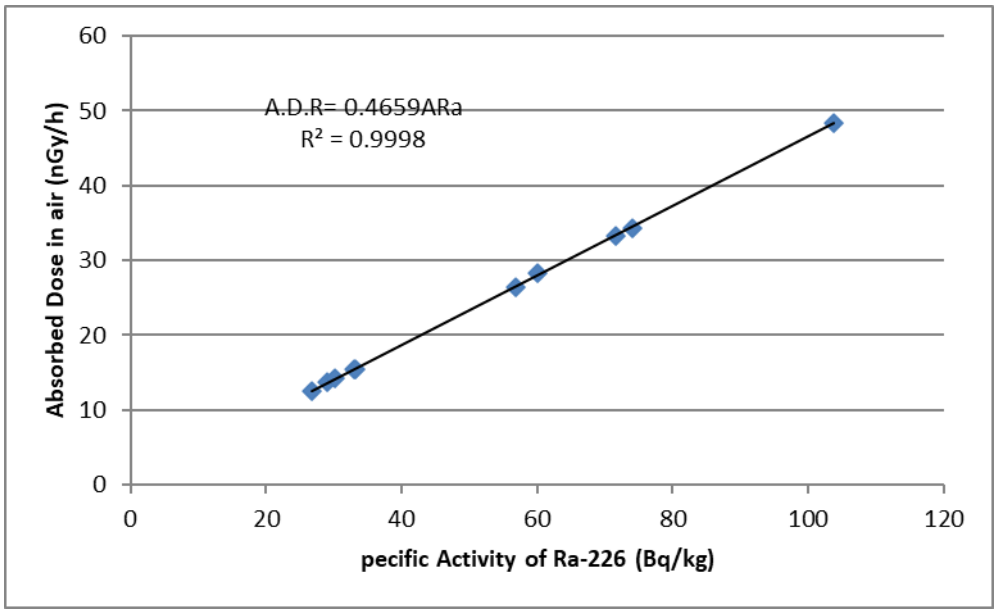


Figure (18): correlation between ^{226}Ra and absorbed dose in air

CONCLUSIONS

The activity concentration of ^{226}Ra, ^{232}Th and ^{40}K has been measured for some soil and rock samples from different locations of West and Mid Libya by using gamma-ray spectrometry (HPGe) detector. The activity of ^{226}Ra, ^{232}Th and ^{40}K in samples are found to ranges from 26.71± 5.95 to 103.31± 11.28 Bq kg^{-1}, 40.74±4.94 to 153.5±16.47 Bq kg-1 and100.35±9.65 to 168.57±17.30 Bq kg-1, respectively. While world average concentrations are 35, 30 and 400 Bq kg-1 for ^{226}Ra, ^{232}Th and ^{40}K, respectively (UNSCEAR, 2000). The average and ranges of activity concentration of ^{226}Ra , ^{232}Th in soil of these areas are quite higher than the world average reported values (UNSCEAR, 2000) while for ^{40}K less than world range . The Average value of radium equivalent activity is 157.25 Bq kg-1 which is below the recommended value of 370 Bq kg-1. T he values of absorbed dose rates due to ^{226}Ra, ^{232}Th and ^{40}K in soil samples vary from 12.47 to34.35 nGy h-1 with an average value of 21.52 nGy h-1 . The calculated values of absorbed dose has been found lower than global average value. The annual effective dose rates in outdoor is found to vary from 0.153 to 0.264 mSv y-1with an average value of 0.297 mSv y-1. This is below the limit of 1 mSv y-1 for general population (UNSCEAR, 2000). The calculated values of external hazard Hex are vary from 0.27 to 0.78 with an average value of 0.45 whereas internal hazard index Hin are vary from 0.34 to 1.01 with an average value of 0.59. All values of Hex and Hin are less than unity except SA10 for H_{in} . However, the value of gamma index Iγ is found to vary from

0.71 to 2.6 with an average value of 1.52 and most values of Iγ were also found higher than one. All the values of Alpha index Iα were found below the maximum permissible value i.e.1.

For samples SA1, SA6,SA8 and SA10 the ratio of activity concentration ($^{226}Ra/^{232}Th$) is less than unity; this is due to that monazite contains more thorium than uranium. Also the abnormal activity concentration and ratio activity concentration ($^{235}U/^{238}U$) that is more than normal (0.026), this phenomena can be explained due to NATO strikes war during 2011, at these regions. The obtained result in this work can be used as the regional base line data for estimation the future radioactivity contamination in the studied regions.

Therefore, the soil of some regions used in the present study is exempted from all the restrictions concerning radioactivity, also these soil samples are safe to be used in building construction. However the soil samples of regions as mentioned above have higher values for ^{232}Th, ^{226}Ra, ^{235}U and radionuclides indices than world (UNSCEAR, 2000)[25]. The mean value of gamma index is obtained above the limit of 1 for most samples. On the basis of these results, researcher concluded that the soil of the study area (in particular regions) have radiological health hazard to the public.

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Effects of gluten on Immunoglobulin A/G Expression in Celiac Patients in Khoms City

تأثير الغلوتين علي إنتاج الأضداد في مرضي السيلياك (مدينة الخمس)

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الملخص:

الأمراض المناعية الذاتية تشمل مرض السلياك تملك تأثيرات في مختلف المجتمعات، مرض السلياك يملك أعراض مرضية مختلفة في الجهاز الهضمي بعد أيام قليلة من هضم بروتينات القمح. ليس هناك دليل طبي مختبري لتأثير البروتينات الغلوتين علي مرضا السلياك، بالرغم من وجود تقارير توضح نشاط الخلايا البائية في الأمراض المناعية الذاتية. والهدف من هده الورقة هو تميز تأثيرات الغلوتين علي إنتاج الأضداد النوع أ و ج في مرض السلياك. الطرق والمواد تشمل 278 مريض وتم الفحص علي الأضداد بالطرق المناعية (إليزا). النتائج وضحت طهور الأضداد بنسبة ضئيلة 10.4% في مرضي السلياك من عمر سنة واحدة إلي ثمانية وأربعون سنة، في المقابل نسبة عالية جداً من هذه البروتينات الغلوبين سجلت في مرضي السلياك من عمر سنة واحدة إلي اثنا عشر سنة. الخلاصة يمكن القول أن هذه الأضداد طهرت بنسبة كبيرة جدا في مرضي السلياك الذين أعمارهم أقل من 12 سنة، هذه الدراسة تقترح عمل دراسات أخري ومقارنة النتائج بعد ثمانية أشهر مع منع المرضي من تناول الغلوبين

Abstract

Back ground: Autoimmune disease include Celiac disease had terrible effects in various societies, is a syndrome differentiated via GIT symptoms occurring in few days after wheat protein ingestion. No medical lab evidence for no-celiac gluten, while a high prevalence of first generation of B-cells activation already been reported in patients with autoimmune disease.

Aim: This project was intended to distinguish the effects of the wheat (gluten) on immunoglobulin A and G (IgA and IgG) expression in patients with CD. **Methods:** immunoglobulin A and G Classes were investigated via using Eliza in 278 patients eating wheat with normal life styles and 278 patients were investigated confirmed with CD**. Results:** the majority of celiac patients showed the disappearance of immunoglobulin A and G with percentage 13.6% and 10.4% respectively, and rage ages between **1** and 48 years. In contrast, high level expression of IgA and IgG has been recorded in patients at ages from one year to 12.Conclusion: it could be said that expression of antibodies of IgA and IgG was disappeared in patients with CD at range ages up to 12 years. This study recommended doing another study in patients with CD less than 12 years, also comparing results with celiac disease patients after 8 months of gluten free diet.

Key words: immunoglobulin, Celiac disease, Eliza

Introduction

Celiac disease (CD)is a chronic inflammatory disorder associated with dietry gluten in genetically predisposed individuals (1). The united prevalence values for CD varies in south Amrica, Africa,NorthAmrica, Asia,Europe and Oceania;the prevalence is higher in female than male individuals and is 4-8 times higher, the most reported indicated 1% approximately all over the world (2, 3). CD is distinguished immunologically via intestinal and/or extra intestinal manifestations, elevation of specific antibodies such as anti-gliadin and anti-tissue transglutaminase (anti-tTG), and the presence of human leukocyte antigen (HLA-DQ2/DQ8) haplotypes (4, 5). Gluten proteins are illustrated via high proline and glutammine content, is a multifarious combination of seed storage proteins known as prolimins, originate in cereals grains such as wheat, barley, rye, oats and their derivatives (6). Proteins are partially degraded to peptides by digestive proteases of the gastrointestinal track (GIT) that carry on in the intestine and potentiate their dimidiation through GTI (7). Hypothesis of immune pathogenesis could be prevented by the two-signal model, which establishes that gluten has adual effect on the duodenum of celiac patients mediated by innate and humeral immune systems (8, 9). Nowadays, the barely obtainable treatment for CD is firm, lifelong gluten-free diet (GFD).Dietary gluten restriction is a safe and effective therapy; on the another hand, unintentional gluten exposure on a gluten free diet (GFD) is common and intermittent (10, 11). Topical finding recommend that most CD patients can only attain gluten. Reduced diet instead of the recommended strict GFG gluten exposure possibly will be more common than realized and, was distinct from lapses in otherwise in tentionally strict GFD (12, 13).

Among the central causes of gluten exposure in a GFD is the omnipresent nature of gluten food cross-contamination ,and the limitations and socio-emotional toll. Furthermore numerous of the manufactured gluten-free products tend to be less healthy than their analogues since high amounts of lipids,sugars and other additives are incorporatedin their production to simulate the viscoelastic properties of gluten protein (14, 15). Quite a lot of researches dependent on nutritional questionnaires, evaluating gluten immunogenic peptides in feces and urine,serological tests, and another medical tests have been indicated variable gluten exposure rates in patients with CD, reaching up to 69% in adults,64%in adolescents, and, 45% in children despite their best efforts to avoid it (16, 17, 18).

The promising therapeutic options for CD will be generally classified into one of the following strategies known as potential alternative non dietary treatment for CD include; inflection of intestinal permeability (19), Immune modificatio and stimulation of gluten tolerance (20, 21), elimination of toxic gluten peptides before reaching the GIT (22).

Methods and Materials

Enzyme Immunoassay for the Quantities determination of both anti-tTG IgA and anti-IgG

Known anti-tTG for enzyme immunoassay (EIA) for the quantitative measurements of immunoglobulin A and G class antibodies to tissue tranglutaminase in human serum. This procedure was intended for in vitro diagnostic of CD patients.

Principle of tests

Anti-TG immunoassay is an indirect ELIZA for the determination of IgA and IgG to transglutaminase in patients serum. The first steps, specimens was combined with human recombinant TG inside cells, and specific antibodies presented in the samples bind to the above antigens (Epitopes) coated microwells. After washing horseradish peroxidase (HRP) conjugated anti-human immunoglobulin are added to form conjugated antibody antigen complex. Following another wash, TMB substrate was introduced, which produced a blue-colored products. Following the addition of stop solution, the color tums to yellow. The final measurement was carried out at the wavelength at 450 as company recommended. A direct relationships exists between the amount of TG antibodies in the sample and absorbance detected by the union system optics.

Sample collections and assay procedure

Collected serums were used as standard sampling tubes, all tests were avoid used specimens with many conditions include grossly hemolysis, lipemia, microbial contamination. All reagents were put at 18-25°C before measurements. Following bringing samples, the package already opened, took the strip out required, made sure that substrate contained in well, is colorless, discard strips which did not have this characterizes. Anyway, dispense 100µl of undiluted samples, 150µl of calibrators, insert strips into the tray in union and start run immediately. Furthermore, the system would perform the following procedure automatically. Then, pipette sample gently incubated at 25°C. Discards the contents three times with added conjugated, discard again with added substrate and stop solutions, mixed and read the

results. To perform union anti-tTG Ig calibration was accepted and stored for each step, all subsequent samples was tested without further calibration unless as company recommended (SHENZHEN YHLO BIOTECH.CO.LTD, China). The union automatically calculating the value of each samples based on the adjusted standard curve to obtain the corresponding values of concentrations expressed in AU/mL.

Statistical analysis

Statistical data were done via Microsoft Excel statistical program to draw charts to find difference percentages of all specimens. Data represnted as mean using Kruskel wallis. n= three reading for each samples.

Reustls

Researche was done to exame blood specimens using ELIZA system looking for expression of immunoglobulin A and G in Celiac pateints were 278 (133 female,47.8%) and (145 male, 52, 2 %) showed in figure 1 . immunoglobuline IgG Presented in olnly 29 pateints with over all percentage (10.4%) as showed in figure 2. Results also indicated high level express of Immunoglobulin G at age between one and twelf years as iullstrated in figure 3. Where, this study was include pateints of 18 (62%), 7(24%), (7%) 2, and (7%) 2 positive samples with mean ages (range (1-12y), (12-24y), (34-36y) and 36-38y) respectively.

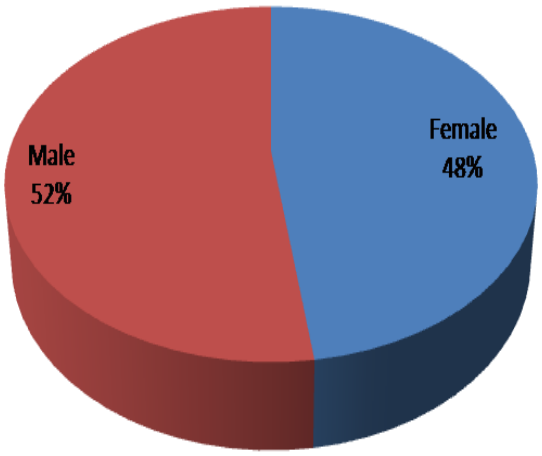

Figure 1: Excel daigrame showing case details in this study, 278 blood specimens Celiac patients include 133 female and 145 male.

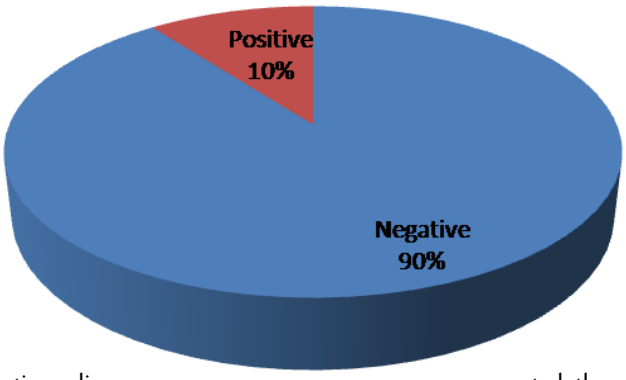

Figure 2: Shematic diagrame reprsented the expression of immunoglobulin G assessed by Eliza to determine the extent of gluten (wheat) influetion on pateints with celiac disease. There were quitly less expression of IgG with various ages from 1 to 48 years.

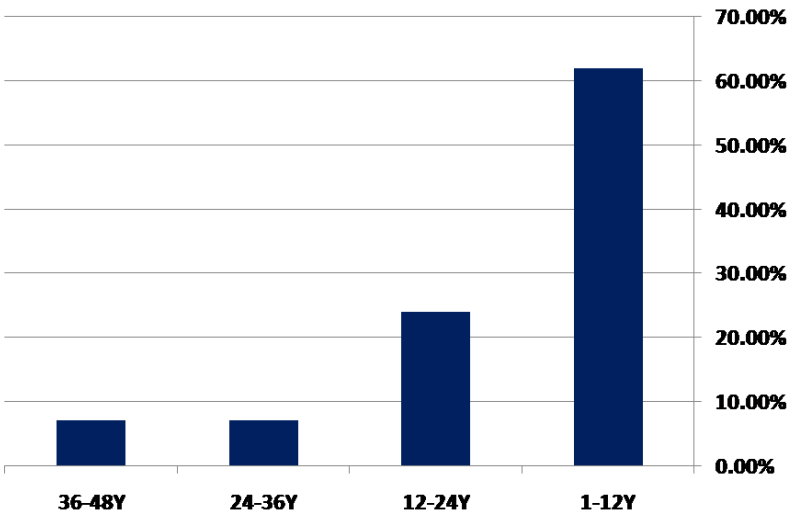

Figure 3: Data was presented high level expression of immunoglobulin G in pateints with celiac disease with range age between 1 and 12 years compared to pateints with range ages between 12 and 48. Data was presented as mean using Kruskal-wallis,n=3.

The same study was done on immunoglobulin A using Eliza system as mentioned in previous chapter (methods& material). Study include 133 female and 145 male with range 47.8% and 52.2 respectively as showed in figure 1. 278 pateints confirmed diagnosis of celiac disease, all patients aviod another disease include diabetes milluts, hyperthyriodism, another allergic disorders. Results domenstrated low level expression of immunoglobulin A generally with various ages and the percentage was approximately 13.6% as showed in figure 4. On the another hand, major level exprssion of IgA was associated with celiac patients at range ages between 1 and 12 years (figure 5).

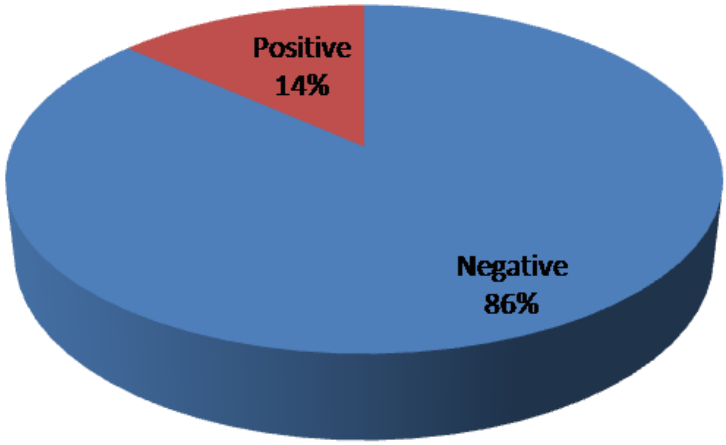

Figure 4: Circular diagram shows the effect of celiac disease on expresssion of IgG with varing ages, lower expression recorded of all samples comparing to their ages between 1 and 48 years.

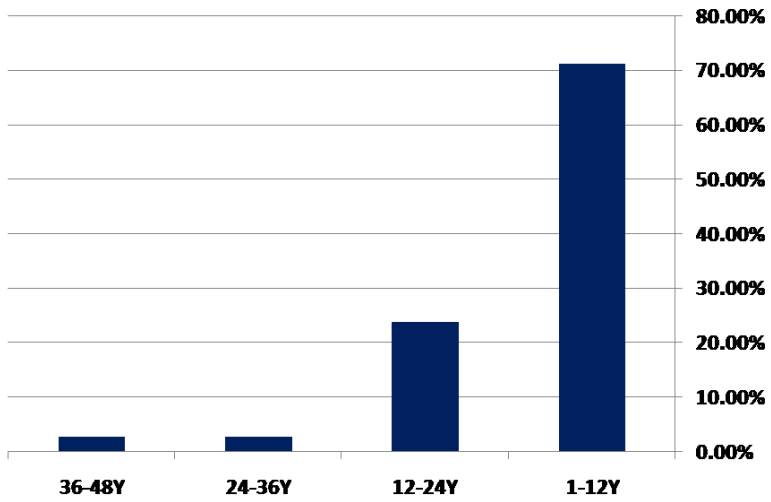

Figure 5: Statistical analysis illustrated label immunflourescence of immunoglobulin A within bloood specimens using Eliza program. It was showed high level expression of IgA in pateints with celiac disease at ranges ages between 1 and 12 years comparing with varing ages (12-24Y), (24-36Y), (36-48Y), percentage 23.7%, 2.6%, 2.6% respectively.

Discussion

CD is a umique autoimmune disease in that its key various elements with reported prevalences of 0.5-1% of general population, with the omission of regions showing low frequency of CD-predisposing genes and low gluten constumption (e.g. sub-saharan Africa and Japan (23). in spite of the progessive awareness of its extistences, is silent a conditions with many unanswered inquiries. Indeed, the national health and nutritions investigation reviews has identified more humndred cases of non-celiac gluten sensitivity NCGS over 7000 subjects (age range 6-70 years) in 2019-2020 interlude with weighted prevelance 0.55%.In this paper, it was aimed to provide a through review on the multifaceted featured spaning from its clinical diagnostic, iummune-pathogenesis, enivromental epidemiological as well as therepeutic strategies in order to help medical doctors and gastroentrologists improving clinical diagnostic (24). Many different researches have shown gluten compounds could causes an immediated and transient increase in intercellular tight junction improving leukocyte immigration as well as pro-inflammatory molecules(23, 25). All these effects could be linked of releasing of immunoglobulines family which in turn increase paracellular permeability causing tight junction disassembly (26). In contrast, results of this research indicated generally low level expression of immunoglobulin A and G in celiac pateints with percentage less than 15% with various ages between 1 and 48 years. This finding was agree with many various researches including experience at celiac disease Centre of Storsola-Malpighi Hospital in Italy, the ratio was between the new non-celiac gluten sensitivity less than 1.6%, confiming a considerably higher prevelance of NCGS Vs CD (27).

Although, various studies indicated that specific antibodies for CD could be detected in the vast majority of patients, small number of CD pateints (around 2-3%) test negative for serological markers. In spite of our study recored high level expression immunglobuline A and G in celiac pateints at ages less than 12 years (percentage more than 60 %). A seropositive CD at age less than 12 years should be detected with villous atrophy on the doudenal histology.

Conclusion

This study documented in this project provides evidence that gluten (wheat) effects on celiac patients at age less than 12 years . Another way, it could be said that expression of antibodies secreted from plasma cells were low in patients up to 12 years.

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SPELLING ERRORS AMONG LIBYAN UNDERGRADUATES

الاخطاء الإملائية لدى طلبة الجامعات الليبية

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الملخص:

فى الغالب المفردات في اللغة الإنجليزية لا يتم نطقها كما يتم كتابتها، كما أن التهجئة باللغة الإنجليزية تتبع فيها بعض القواعد الأساسية ، ومن المستحسن استخدام هذه القواعد. يحتاج الطلاب إلى تعلم قواعد التدقيق الإملائي واستثناءاتها أيضًا. ومع ذلك ، يواجه طلاب اللغة الإنجليزية صعوبات في التهجئة وهذا يبدو جليا عند الطلاب الذين لغتهم الأولى ليست الإنجليزية. فغالبا ما يقع الطلبة الليبيون في كلية الآداب والعلوم مزدة قسم اللغة الانجليزية في أخطاء إملائية عندما يتعلق الأمر بكتابة الكلمات باللغة الإنجليزية. ولهذا يكمن السبب الرئيس وراء إعداد هذا البحث هو تحديد الأنواع والأسباب الكامنة وراء وقوع الطلاب فى أخطاء إملائية والمتمثل في طلاب السنة الثانية قسم اللغة الانجليزية بكلية الآداب والعلوم مزدة بجامعة غريان. أقيمت هذه الدراسة باختيار عشرين طالبا كعينة مكونة من ذكور و إناث. كما تم الحصول على بيانات الدراسة باستخدام اختبار تحريري واستبيان تم إجراؤه على عشرين طالبًا. كما تم استخدام ست معايير لتقييم الأخطاء متمثلة في الإملاء، المرادفات، والاستبدال، والحذف، وقواعد التهجئة، والتبديل. تم تحديد الأخطاء الإملائية من الفئات المختلفة وتجميعها ثم تحليلها. أوضحت الدراسة أن أعلى نسبة أخطاء كانت في فئة الاستبدال (69.2٪). وتشير الدراسة إلى أن السبب الرئيس للأخطاء الإملائية هو التداخل اللغوي بين الغة الأم واللغة الثانية، والاختلاف اللغوي بين اللغتين العربية والإنجليزية، بالإضافة إلى عدم إدراك الطلاب للأخطاء الإملائية في اللغة الإنجليزية. كما تشير النتائج إلى أن المعلمين مطالبون بإبداء المزيد من الاهتمام بالأنواع الرئيسية من الأخطاء الإملائية ويجب أن يشجعوا الطلاب على ممارسة اللغة الإنجليزية في كثير من الأحيان حتى يتقنوا قواعد الإملاء لتجنب الوقوع فى مثل هذه الأخطاء مستقبلا.

كلمات مفتاحية: أخطاء إملائية، التداخل اللغوي، الاستبدال، المرادفات.

ABSTRACT:

Words in English are not always spelled as they are pronounced. English spelling follows some basic rules, but there are always acceptations to these rules. Students need to learn spelling rules and their exceptions as well. However, English Students face difficulties with spelling especially those whose first language is not English. Libyan undergraduates of Mizdah Arts and Science College commit spelling errors when they write English words. The main reason behind conducting this research is to identify the types and reasons behind making spelling errors by second year students of Mizdah Arts and Science College at Gharian University. In all, 20 students made up of females and males were used for the study. The data for the study was obtained by using a test and a questionnaire were administered to twenty undergraduates. There are six error categories used in the spelling test; homonyms, substitution, omission, spelling rules, transposition, and phoneme-grapheme irregularity. Spelling errors of various categories were identified, computed, and grouped. The study revealed that the highest percentage of errors was committed on substitution category (69.2%). The study indicates that the main cause of spelling errors is the first language interference, the linguistic difference between Arabic and English languages, in addition to the lack of the students' awareness of the English spelling errors. The findings suggest that teachers are required to pay more attention to the major types of spelling errors and should encourage students to practice English more often until they master the rules of spelling.

Keywords: Students spelling errors, teaching method, ESL writing, academic writing

INTRODUCTION

1.1 Area and topic

Spelling difficulty is one of the most common problems that face Libyan undergraduates in learning English. It is a very complex skill especially in a language like English where its orthography is different from the way words are spelt. Most learners of English in Libya are frustrated by the poverty of their spelling proficiency. Although some students may think that the content is more important than the way its spelling appears, the content will not be fully understood when the graphic symbols are misspelled. However, making mistakes is a sign of learning. Making errors is a positive sign of learning, Cook (1997). Al-Khaffaji and Al-Shayib (1987) state that "to spell correctly makes written communication easier while misspelling might lead to interruption of communication and misunderstanding.

Although it's important for English learners to write with accurate spelling, there are a limited number of researches on this matter. However, exploring and analyzing error spelling is urgent in order to improve spelling proficiency. Therefore, this research is investigating spelling errors made by undergraduate students of English in Mizdah Science and Arts College and aims at finding some factors that may contribute to making such errors.

1.3 Aims of the Study

The purpose of this research is to find out what kind of spelling errors are made by undergraduate students in Mizdah faculty and also to investigate responsible factors for making such kind of errors.

1.2 Importance of the Study

This study will be beneficial for teachers, students, and those who are responsible for ESL. It aims at creating an awareness that will draw the attention of English language users to these errors. However, this study provides some insight on different kinds of errors found in written essays of undergraduate students so that they do some efforts to avoid repeating such errors. Moreover, this study guides teachers not only to identify the problem of spelling but also to find some suggestions and solutions that are needed. It has been observed that Libyan undergraduates' spelling proficiency of English language is generally low. Most of them are supposed to have difficulties in writing words they have already learned.

1.4 Research question

This research aims at answering the following questions:

1. What kind of spelling errors is made by undergraduate students?

2. Why do undergraduate students make such kind of errors?

3. How can teachers in the faculty of Science and Arts in Mizdah help students to minimize spelling errors?

1.5 Methods

The research methodology used in conducting this study includes a test and a questionnaire. The sample consists of twenty undergraduates who are specialized in English language at their second year at Mizdah faculty of Science and Arts during the academic year (2019- 2020), their age is between (19-21) years old.

CHAPTER ONE

CAPTER TWO

LITERATURE REVIEW

According to Coder (1981) there are two schools concerned with learners' errors; the first school believes that in order to achieve a perfect teaching method, errors would never be committed in the first place. Therefore, the occurrence of errors is a result of our inadequate teaching technique. Whereas the second school maintains that errors will always occur in spite of our constant efforts because we live in an imperfect world. We should concentrate on effective techniques to deal with errors.

Corder (1981) made a comparison between the terms "errors" and "mistakes". Errors occur as a result of the lack of competence whereas mistakes occur as a result of failure in competence. Errors are more important than mistakes because they are beyond learners' knowledge. They are Important for three reason; they show teachers what students have learned; they offer researchers a deep insight into how languages are learned; it helps students learn the rules through the feedback from their errors.

Several studies have been carried out with students of various nationalities at different levels starting from elementary to undergraduates. For example, previous studies carried out in the Arabic EFL context by Al-Sobhi (2017) revealed that the spelling errors of EFL Arab learners could occur for different reasons such as first language interference which includes errors caused by the linguistic difference between English and Arabic languages. Other researchers such as Tshimo (2018 and others) revealed that the lack of knowledge of the orthography rules leads students to commit spelling errors. Dadzie &Bosiwa (2015) attributed the low level of the students' performance to L1 interference, ignorance, transfer, false analogy, and lack of interest reading wide among students.

2.1. English spelling

Spelling is defined as the process of forming words using the proper letters in the correct order according to common principles of accepted usage for a particular language. Essinger (2006) An example of spelling is when you actually say or write the letters of the word "car." as "C" "A" "R." Al-Saedi (1989) defines spelling as "putting the elements (letters) of each word in the right sequence. It is also the ability to write words correctly depending on the memory. Spelling is an important activity in the process of learning a foreign language". Al-Khaffaji and Al-Shayib (1987) state that "to spell correctly makes written communication easier while misspelling might lead to interruption of communication and misunderstanding.

Essinger (2006) states that spelling is the study of:

-Phonetics: as related to the grouping of words for spelling, such as: *an, man, can.*

-Syllabication: learn to divide word and spell by syllabication, such as: dic- ta- tion, re- la- tion.

-Prefixes and Suffixes: what they mean and how to use them.

2.2. Importance of Spelling

One of the very important matters to consider with writing competency is spelling. One single misspelled word can change the entire meaning of the sentence. Cook (1997) elaborates that "… correct spelling is a sign of education; a spelling mistake is a solecism that betrays carelessness."

In English, some words are written by alphabets that do not sound the actual sound as required by the word. In few other languages, the alphabet carries a specific sound. For example, there will be fewer spelling errors if we write words in Arabic. English has two different types of wording; British English and American

English .For example, the word “color” is from British English while the same word is written as “color” by American terminology.

Many students think that spelling has become less important lately. They believe that there is no need to care about spelling rules because of the availability of some software and Internet browsers that automatically detect spelling and grammatical errors. However, Teachers, linguists, journalists and editors claimed that it is essential to keep good spelling for written content. This implies the credibility of the content, the entity, and the message conveyed.

2.3. Spelling problems of English:

Cook (1991) asserts that "unlike native speakers, students may not know the actual system of English, and will appear to use the wrong letter." Making errors is a positive sign of learning. The complexity of English spelling could be a real challenge for both learners and native speakers of English. However, most common spelling errors are due to homonyms, inflection, foreign words, and constant alterations. Even well-educated Americans find themselves uncertain about how to spell some common words .Dobie (1986)

Most of English spelling difficulties come from the fact that words are spelled according to their historical form rather than their sound. In other words, English spelling is etymological rather than phonetic. Thus the word *tough* is spelt as its form now because in old English it was pronounced with a guttural sound represented by *gh*, even though nowadays it is pronounced like ruff.

METHODS

3.1. Subjects of Study

The sample of the study includes twenty students of second year at English department, Mizdah Arts and Science College who have been studying English for two years at the university. The reason behind carrying out this research is to know the reasons why those students tend to commit spelling errors.

3.2 Data collection

The data collecting for this study started in May in 2019 and finished in the same month of the same year. Two techniques of collecting data were used in this study; a spelling test was used in order to find out the undergraduates’ level of orthography rules. The second technique used in this study is a participants’

questionnaire. It was used to investigate the students' background of spelling rules and to what extent second year students are capable of writing efficiently.

Findings

The misspelled words committed by second year students were grouped into six categories in a form a table. It includes Homonyms, Substitution, Omission, Spelling rules, transposition, and Phoneme-grapheme irregularity. A percentage for each item is given and followed by an analysis of the results obtained.

Tabel (I)

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent

NO	Categories	N. of correct responses	Percentage	N. of incorrect responses	Percentage
1.	**Homonyms**	**70**	**70 %**	**30**	**30 %**
2.	**Substitution**	**30**	**30 %**	**70**	**70 %**
3.	**Omission**	**60**	**60 %**	**40**	**40 %**
4.	**Spelling rules**	**80**	**80 %**	**20**	**20 %**
5.	**Transposition**	**40**	**40 %**	**60**	**60 %**
6.	**Phoneme-grapheme Irregularity**	**60**	**60 %**	**40**	**40 %**

*Homonyms * S.rules * Transposition * P.G.irregularity*	10	100.0%	0	.0%	10	100.0%

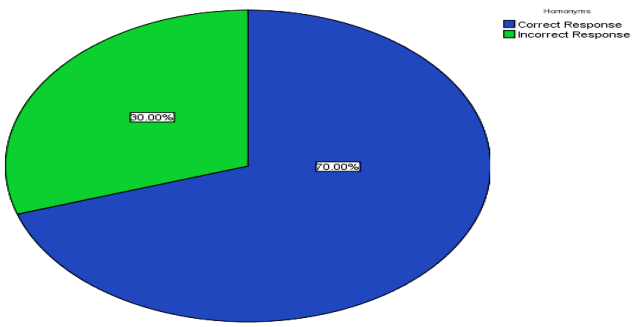
*Substitution * S.rules * transposition * P.G.irregularity*	10	100.0%	0	.0%	10	100.0%
*Omission * S.rules * transposition * P.G.irregularity*	10	100.0%	0	.0%	10	100.0%

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.583	43.057	43.057	2.583	43.057	43.057
2	1.249	20.819	63.876	1.249	20.819	63.876
3	1.096	18.264	82.140	1.096	18.264	82.140
4	.828	13.798	95.938			
5	.244	4.062	100.000			
6	1.828E-16	3.047E-15	100.000			

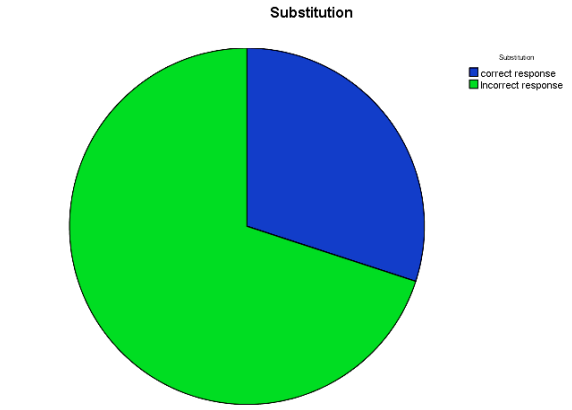
Extraction Method: Principal Component Analysis.

1. **Homonyms**



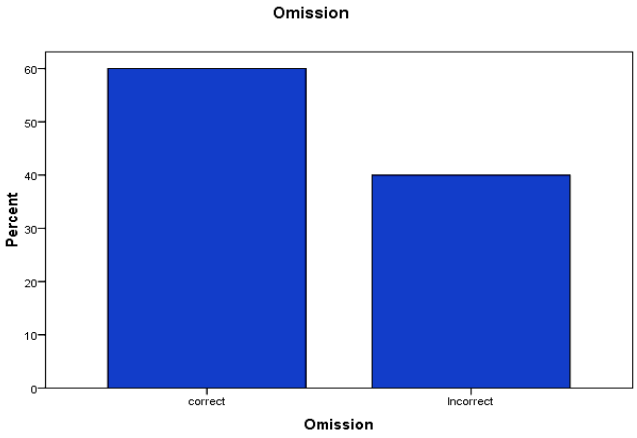
Homonyms errors are committed when words spelled the same and sounds the same as another are used, but different in meaning or origin. Most students get confused with these words. The results of the first item show that the percentage of students' incorrect responses is (30%), whereas (70 %) of students' responses were correct. Students found it difficult to distinguish homophones like *there* and *there*, *peace* and *piece*, *right* and *rite* etc

2. Substitution



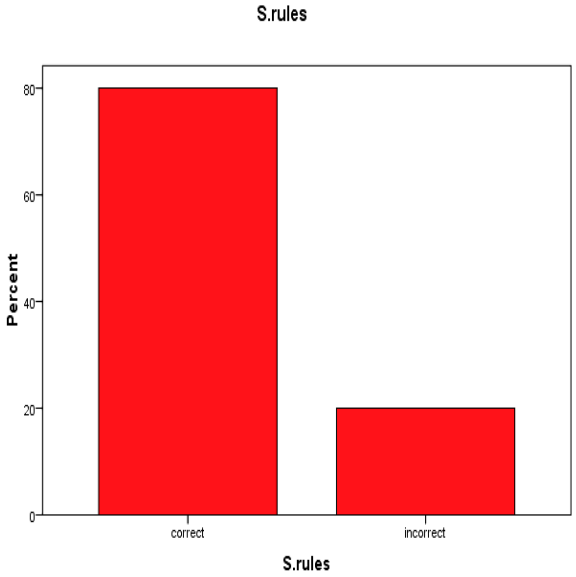
Substitution errors occur when a learner replaces the right form with an incorrect one. They substitute one letter or two in a word. The participants made the highest percentage of errors in this category (70%) for example *pacient* for patient, *yogort* for yogurt, and *sboon* for spoon. Some words could have been misspelt because of their pronunciation. Simply, they misspell words because the mispronounce them.

1. Omission



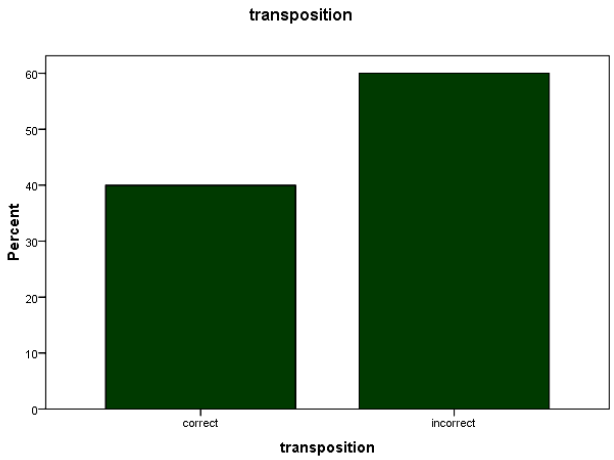
Omission errors occurred when a letter or two is missing from the word. As shown in the table above. About (40 %) of the students have omitted a letter or two from the words. for example, *lonly* for lonely*; depresed* for depressed; and *bord* for board.

…**Spelling rules**



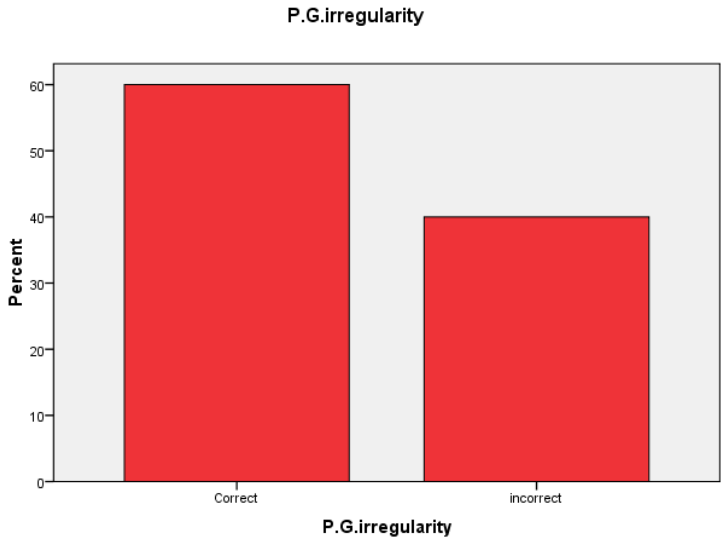
The spelling rules test showed that (80%) of the participants' answers were correct, whereas (20%) of their answers were incorrect. The percentage of the spelling test indicates that most of the students have a considerable idea about the rules but they have problems with using them probably.

1. **Transposition**



Transposition errors occur when adjacent letters are replaced by one another. The participants committed a high number of errors in this category (60%). Most of the transposed letters were “e” and “i” for example *freind* for friend and *recieve* for receive.

1. **Phoneme-grapheme irregularity**

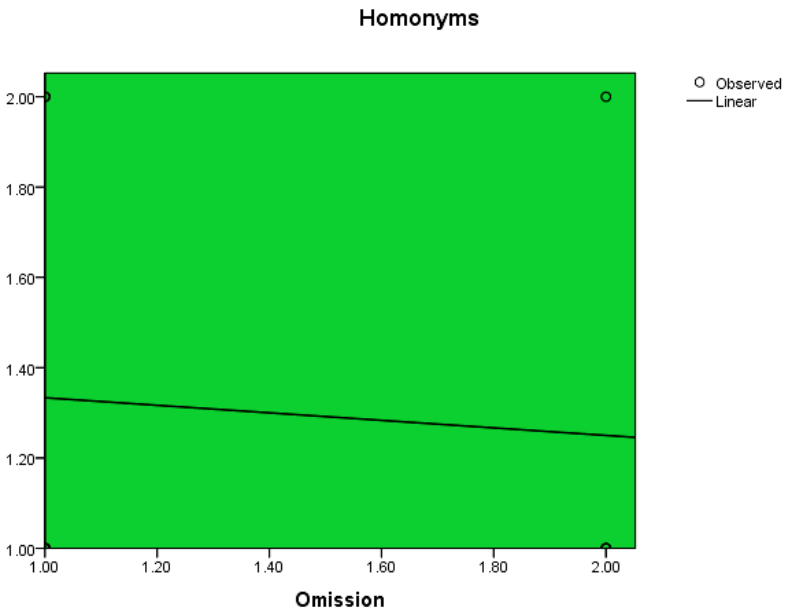


Phoneme-grapheme irregularity includes *"gh, ph" =(f,) "ure" =(ʧ, ʒ), "sion, ssion, tion" = (ʤ, ʃ) "ch, sh, s, z" = (k, ʃ, ʧ, s, z)* .The findings reveal that many of the students have problems with phoneme-grapheme irregularity (40 %). The highest percentage of error was committed with the words that contain “ure” (80%). letters which represent the sounds /ʧ/ and/ʒ/, for example *closour* for closure. Another spelling error was made with “sion, ssion, tion" = (ʤ, ʃ) like *explosion, commission, and nation*. About 80% of the participants failed to give correct spelling. For the letters "gh, ph" = (f,) like *enough* and *laugh* only 60% students were able to give perfect spelling. Finally, for the combination “ch, sh, s, z" for example, *chemistry*, *splash*, *practice*, and *sugar*. Here, the participants have made the least percentage of errors with only (28.5%) .

DISCUSSION

The students’ errors were identified, computed, and grouped into six categories; Homonyms, Substitution, Omission, Spelling rules, transposition, and

Phoneme-grapheme irregularity as shown in figure I above. Based on the errors identified, the substitution category was the most frequent error with a percentage of (70%) The second highest category is transposition error with (70%) this confirms the findings of some previous studies of Tshimo (2018), Al-Sobhi (2017) and Albalawi (2016) as most students committed errors in substitution category. This could be a result of the way Arab students internalize the pronunciation of words. Findings affirmed that Libyan second year students make more spelling errors with frequent words. Students seem to concentrate on the sound of the words rather than their forms. In English, some words are written by alphabets that do not sound the actual sound as required by the word. In few other languages, the alphabet carries a specific sound. For example, there will be fewer spelling errors if we write words in Arabic. Therefore, they omit some letters that are not pronounced. Students and teachers should pay more attention to the fact that English spelling doesn't only convey pronunciation but information as well. This could be clearly shown in the figure below



According to Richard (1971) students learn English language like acquiring their first language. Therefore, the interference of native language leads to making language errors. Overgeneralization errors occur when students use their previous strategies of their first language in learning a new language. For example, "drinked" for drank, "cutted" for cut, and "singed" for sang. The findings of the study also confirm that second year students committed spelling errors as a result of overgeneralization. The finding of this study confirms earlier study of Tshimo

(2018) that mother tongue interference pronouncing and spelling some English words.

By analyzing the students' questionnaire, it was revealed that the majority of students believe that they are good spellers. However, the spelling test analysis proved the opposite. Most of them faced difficulties to write correct words. Moreover, most of the students claimed that their previous teachers paid enough attention to spelling rules. (90%) of the participants believe that spelling is important nowadays. This reveals that students are aware of the importance of writing correct spelling even with the availability of spelling checker software.

CONCLUSION

Due to the importance of orthography, this study has been carried out to identify the main types and causes of spelling errors made by Libyan second year student at Mizdah Arts and Science College. The analysis of the findings revealed six types of spelling errors committed by second year students. These were homonyms, substitution, omission, spelling rules, transposition, and phoneme-grapheme irregularity. These categories were grouped in a form of a table. The highest percentage of students' spelling errors was substitution followed by omission category. The study revealed that the linguistic difference between Arabic and English languages could be one of the main reasons of making spelling errors. The interference of mother tongue has great impact on the way students learn English as a foreign language. The study also revealed that some students have a very limited knowledge of the spelling rules. As a result, students may mistakenly omit, transpose, or substitute a letter(s) when writing English words. Therefore, it can be concluded that the errors related to the six categories can be attributed to students' lack of knowledge of spelling rules.

The questionnaire analysis revealed that students are aware of the importance of orthography. They believe to be good spellers. However, the results revealed that most of them commit different types of errors. This is an indication that second year students have a problem with spelling which attributes the poor performance at the spelling test.

As far as the problem of spelling is concerned , we do recognize that it is not easy for students to overcome their difficulties which became a constant habit throughout English as a second languages at the undergraduate schools. The reasons which prevent them from improving their levels in spelling are multiple and deeply rooted within their contexts and inside themselves as well as the interference of L1 & L2. It's really recommended to teachers to pay more attention to the major types of

spelling errors and encourage students to practice English more often until they master the rules of spelling.

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